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*"On the Leiotrichane Birds of the Subhemalayas," by B. H. HODGSON, Esq. : with some additions and annotations,—a Synopsis of the Indian Pari,—and of the Indian Fringillidæ, By E. BLYTH, Curator of the Asiatic Society's Museum.*

### LEIOTRICHANÆ.

*Leiothrix*, Swainson.—Bill short, strong, more or less conic, the culmen and gonys equally curved before the nares, and the tomia scarpt : tip of upper mandible strongly inclined over the lower, with salient notch [?], but not Lanian [or Shrike-like] ; of the lower obtuse, entire, and straight. Nares distinctly fossed, advanced, implumose, lateral ; the aperture more or less lunated by the more or less hardened and scale-like tect. Rictus moderate, furnished with long but feeble bristles : nares also furnished with hairs. Wings short, round, firm, bowed, with five primaries graduated, the sixth and seventh equal and longest. Legs and feet very strong ; tarse a third longer than middle toe and nail, and nearly or quite smooth : toes medial, unequal, depressed, the anterior basally connected, the outer more so and longer ; the hind large and broad, *alone* exceeding the inner digit, and with its nail the outer, but not equal to the central toe and nail. Nails strong, compressed, falcate ; hind largest. Tail short, lyrate, mucronate.

Type *Leiothrix furcatus* ? [Swainson, or rather *sincensis*, being the No. 156. No. 72, NEW SERIES.

*Tanagra sinensis*, Gmelin, founded on *la Mesange de Nankin* of Sonnerat, which is referred to *Parus* by Temminck, *p. c.* 287, fig. 1, a figure which is cited by Mr. Swainson, who assigns "India" as the habitat; and deducing his generic diagnosis from the present species, that systematist writes—"Tail moderate, deeply forked," this being a feature unnoticed in Sonnerat's description, which evidently refers to the species under consideration, wherein the form of the tail may be compared to that of a female black Grouse (*Tetrao tetrix*), but having its central pair of feathers a third shorter than the rest.] *L. calipyga*, Mihi [being also *Bahila calipyga*, Hodgson, *Ind. Rev.* 1838, p. 88; subg. *Calipyga*, *Ibid.*, *J. A. S.*, X. 29.] Above and flanks sordid vernal green [or olive-green, tinged with yellow on the crown]; below gamboge-yellow [the belly yellowish white]; outer margin and base of the primaries the same; centrals [i. e. secondaries] edged with sanguine; rest of alars and caudals black. Bill coral-red: legs fleshy-brown. Female with the caudals green like the back, and the central alars not edged with sanguine. Length six inches and a half, the bill five-eighths of an inch; wing two inches and nine-sixteenths; tail two and one-third; tarse to sole an inch and one-sixteenth; central toe and nail three-quarters of an inch; hind-toe five-eighths: weight about 1 oz. *Hab.* central and northern hilly regions [of Nepal]; feeds equally on grass-seeds, and upon insects and their larvæ and pupæ. [The foregoing description of this bird refers to the newly moulted plumage, for as the feathers become old the colours fade very considerably, the green of the upper parts changing to plain grey, the yellow of the throat and breast to a dull buffy hue, and the yellowish tinge of the abdominal region disappears altogether. Analogous losses of colour occur, to a greater or less extent, in the other species, but particularly in the next; and in like manner the bright yellow on the wings of *Garrulax chrysopterus* and certain allied species, fades to whitish-grey, and the *Cissa sinensis* (v. *Kitta venatorius*, Gray), which at first is of a beautiful and deep sea-green, becomes gradually of a pale verditer-blue, while the sanguine hue bordering its large wing-feathers changes to dull leaden-grey; the same being more or less observable in all the various forms (so common on the Himalaya) which have wing-markings of the same general character as those of *Leiothrix*, *Garrulax* (v. *Ianthocincla*), &c.]



## SUBGENERA ?

*Fringilliparus*, Mihi. [*Mesia*, Hodgson, *Ind. Rev.* 1838, p. 34 ; and since *Philocalyx*, H., *J. A. S.*, X. 29.] Bill longer, wings longer [certainly not in proportion, nor even quite so long], not bowed, more acuminate, with but four primaries graduated, the two next being equal and longest. Tail medial, broad, firm, even, with the tips of the feathers nearly squared. [N. B. With several specimens both of this and the preceding type before me, I can perceive no character whatever that should entitle them to separation, and do not even recognise the distinctions of form indicated by Mr. Hodgson, their chief diversity consisting in the shape of the tail, which in the present species is scarcely truncated, and has the outermost feathers a little shorter than the rest.]

Type, *F. argentauris*, Mihi. [*Mesia argentauris*, Hodg., *Ind. Rev.* 1838, p. 88.] Body slaty, paler below, and smeared green above ; [in new plumage, tinged with green on the upper parts, the nape dark golden-fulvous, throat and breast bright gamboge having a cast of red, and under-parts deeply tinged with yellow :] cap black, enveloping the silvery ears : [feathers at] base of bill yellow, and the outer margin of primaries and lateral caudals the same : upper and lower tail-coverts and base of wings [i. e. a large patch at the base of the primaries and secondaries,] sanguine : legs and bill pale fleshy-yellow. Female with the tail-coverts yellow [fading to fulvous or tawny]. Length seven inches to seven and a quarter ; of bill three-quarters of an inch ; wing three and one-sixteenth ; tail two and three-quarters to three inches ; tarse an inch and one-sixteenth ; central toe and nail thirteen-sixteenths ; hind-toe ten-sixteenths.

*Ioropus*, Mihi. [*Siva*, Hodgson, *Ind. Rev.* 1838, p. 88 ; and since *Hemiparus*, *Ibid.*, *J. A. S.*, X. 29.] Bill various, more slender and Meruline, or shorter and more Parian ; wings short ; feet as in *Zosterops* or *Iora*, with short anteal toes, but tarse high as in the last. Tail more or less elongated, and gradated from sides and centre as in *Parus* ; broad, firm, and obtusely tipped, or narrow and frail and wedge-tipped.

Types. *I. strigula*, *cyanouroptera*, and *nipalensis*.

*I. strigula* ; [*Siva strigula*, Hodgson, *Ind. Rev.* 1838, p. 89 ; and figured as *Muscicapa* (*Siva*, Hodg.) *strigula* by M. Adolphe Delessert, in the 2d. or Zoological part of his *Souvenirs d'un Voyage dans l'Inde*, p. 24,

and pl. VIII.\*] Length six inches and a half, bill five-eighths of an inch; tail two inches and seven-eighths; wing two and three-quarters; tarse an inch and one-sixteenth; central toe and nail eleven-sixteenths; the hind three-sixteenths. Head with a full crest of sordid gamboge; body above slaty smeared with green; below gamboge more or less di-

\* In the same work are figured and described, or only described:—

1. As *Chloropsis curvirostris*, Swainson, ("Menag,") the *Phyllornis Hardwickii*, v. *Chl. Hardwickii*, Jardine and Selby, v. *chrysogaster*, McClelland and Horsfield, v. *cyanopterus*, Hodgson, v. *auriventris*, Guérin, (*Magasin de Zoologie*, 1840, Ois., pl. 17).

2. As *Cypselus* (*Chatura*, Hodgson,) *nudipes*, Hodgson, J. A. S., V. 779, the *Pallene macropterus*, v. *Ch. macroptera*, Swainson, *Zool. Ill.*, v. *leuconotus*, *Mag. de Zool.*, 1840, Ois. pl. 20. (Is this identical with the Australian species—*P. caudacuta*, (Lath.), to which, according to Mr. Strickland (*Ann. and Mag. N. H.* 1843, p. 337), must be referred "*Chatura australis*, Stephens, *Hirundo fusca*, Stephens, and *Ch. macroptera*, Swainson"?)

3. As *Francolinus Hardwickii*, Gray, the *Perdix lunulosa*, Valenciennes, v. *Fr. nivosus*, *Mog. de Zool.*, 1840, Ois. pl. 18; if indeed this be not also the Cingalese, *Perdix bicalcaratus* of Pennant, which I greatly suspect. The form, to which *P. spadiceus* also belongs, I regard as constituting a very distinct genus—*Galloperdix*, *Nobis*.

4. As *Crateropus Lafresnayii*, Ad. Deless., the *Garrulax cachinnans*, or *Cr. cachinnans*, Jerdon, *Madr. Jl.* 1839, p. 255, with figure; having been, it would appear, also named *Delesserti* by M. de la Fresnaye.

5. As *Cr. griseiceps*, *Rev. Zool.* 1840, p. 101, the *Cr. Delesserti*, Jerdon, *Madr. Jl.* 1839, p. 256.

6. As *Muscicapa rufula*, de la Fresnaye, the *Saxicola nigrorufa*, Jerdon, *Madr. Jl.* 1839, p. 366.

7. As *Pica bottanensis*, Ad. Deless., *Rev. Zool.* 1840, p. 400, the *P. megaloptera*, Blyth, J. A. S., XI, 193 (1842).

And the following new species are given:—

1. *Turdus* (*Merula*) *nigropileus*, de la Fresnaye; a Neilgherry species distinct from *T. simillimus*, Jerdon, and which has since been likewise obtained by that naturalist: allusion being made in the description to the two Himalayan Blackbirds, *T. pæcilopterus*, Vig., and *T. collaris*, Sorel, *Rev. Zool.* 1840, p. 2, which latter is doubtless the *T. albocinctus*, Royle, *Ill. Him. Bot.* (1839), termed *albicollis* on that author's plate, which name belongs to another species.

2. *Prinia flaviventris*, (Ad. Deless.,) described as an *Orthotomus*, and previously in *Rev. Zool.* 1840, p. 101.

In the class of mammalia, the Gaour, *Bos gaurus*, v. *Bibos cavifrons*, Hodgson, is figured as *Bibos frontalis*, (Lambert,) which name, however, refers to the Gayal of the trans-Brahmapooter territories, *B. govæus* of Colebrooke, v. *B. sylhetanus*, F. Cuv., which is a very different animal: and the Wild Dog of the Neilgherries is erroneously referred to *Canis primævus*, Hodgson, which latter I shewed to M. Delessert, and he at once acknowledged their distinctness, as may be likewise seen by comparing M. Delessert's figure with that of the Himalayan animal in *As. Res.* xviii, pt. ii, 236. The only other Indian quadruped figured is a small Neilgherry squirrel, *Sc. Delesserti*, Gervais, which is nearly allied to *Sc. McClellandii* common at Darjeeling, and *Sc. insignis* of Java.—E. B.

luted; alars and caudals black, passing marginally and laterally into yellow; edge of central alars fiery; outer web of tertials blue-grey; chin orange; throat barred black from a black moustache, large and irregular in shape: legs and bill sordid bluish-grey. Sexes alike. Distinguished by its *quasi*-Parian bill, its crest, and broad composed caudals [also conspicuously by its barred throat]. It passes into the next form or *Proparus*, yet retains the notch on the bill vaguely.

*I. cyanouropterus*. [*Siva cyanouroptera*, Hodgson, *Ind. Rev.* 1838, p. 88; *Leiothrix lepida*, McClelland and Horsfield, *Proc. Zool. Soc.* 1839, p. 162.] Length six inches and a quarter; bill eleven-sixteenths of an inch; tail two inches and a half; wing two and seven-sixteenths; tarse seven-eighths; central toe and nail ten-sixteenths; hind eight-tenths of an inch. Lutescent-brown, passing to blue-grey towards the head; crown and visible part of closed alars and tail cobalt-blue; tertials and tail tipped white, the outer caudals white internally; legs fleshy; bill dusky yellow; sexes alike. Remarkable for its long, straight, and Thrush-like bill; no crest; tail like the last. [The under-parts are much lighter-coloured than the back, and have a faint lake tinge; rump rufescent; and forehead streaked with black. Inhabits also the hill ranges of Assam.]

*I. nipalensis*. [*Siva nipalensis*, Hodgson, *Ind. Rev.* 1838, p. 89.] Length five inches and five-eighths to five and seven-eighths; bill five-eighths; tail two inches and a half; wing two and a quarter; tarse fifteen-sixteenths; central toe and nail five-eighths; hind half an inch. Above olivaceous-brown, below [faintly] lutescent; head [cap and nape] slaty, with dull black long superciliary lines: legs and bill sordid fleshy or horn. In form like *strigula* as to bill and crest, but distinguished for its narrow, rounded, and somewhat rigid tail: with it leads to *Proparus*. [This species and the next are also remarkable for the uniform brown colouring of their wings, all the rest having the wings more or less variegated. It likewise inhabits Arracan.]

*Siva occipitalis*, Blyth. Length about five inches, of wing two and a half, and tail two inches; bill to gape nine-sixteenths, and tarse seven-eighths of an inch. Colour dull brownish olive-green above, the shafts of the dorsal and scapulary feathers pale; below much lighter and rufescent, the throat whitish, the feathers of the fore-neck having dark shafts: crown, nape, and lower tail-coverts, ferruginous-brown, which also tinges

the flanks : coronal feathers considerably elongated ; and the occiput beneath the crest, white : bill black, and legs yellowish-brown. Inhabits Darjeeling.]

*Proparus*, Mihi. [not *Proparus*, Hodgson, *J. A. S.*, X. p. 29, which refers to the next group, or *Certhiparus*, Hodgson, hodié.] Bill quite Parian and entire, but the nostrils are implumose and furnished with an arched scale. Head crested. Wings short, bowed, with four quills graduated, and the three next longest. Tail narrow and cuneate as in the last. Tarse elevate and strong. Anteal digits not shortened : hind lengthened, and with its great nail (which is equal to the digit,) much exceeding the laterals, and nearing the middle toe and nail : nails large but moderately curved. [In a second species referred to this division by Mr. Hodgson, but received subsequently to the present paper, *Pr. chrysotis*, H., the tarse is longer and more slender, and the hind claw less developed, but greatly exceeding the others.]

Type *Pr. vinipectus*, Mihi. [*Siva vinipectus*, Hodgson, *Ind. Rev.* 1838, p. 89.] Length four inches and three-quarters ; bill seven-sixteenths of an inch ; tail under two inches ; wing two inches and one-eighth ; tarse fifteen-sixteenths ; central toe and nail eleven-sixteenths ; hind ten-sixteenths. Above brown, passing into rusty on the rump and outer webs of the alars next the body, and of the caudals [towards their base], both of which are dusky-black externally, and the *primaries* have hoary edges. Below albescent, sordid towards the vent ; wine-tinted on the breast ; a white and a black line above each eye. Legs and bill fleshy-brown. Distinguished by its perfectly Parian bill, without trace of notch, and by its longer but less falcate nails.

[*Pr. chrysotis*, Hodgson. Partakes of the aspect of *Orites* (*Parus*, L.,) *caudatus*. Upper parts and throat ash-grey, tinged with yellow on the rump ; ear-coverts silvery, with a faint lutescent cast ; under-parts bright yellow ; a longitudinal streak of rich orange-yellow on the wing, formed by the margins of the secondaries ; and the outer and graduated primaries narrowly edged with yellow ; inner edge of the tertiaries margined with white, and secondaries having a white spot at tip ; bill dusky-plumbeous ; and legs pale. Length about four inches and a half ; of wing two inches ; and the middle tail-feathers the same ; tail much graduated : bill to gape barely half an inch ; tarse thirteen-sixteenths ; hind toe and claw nine-sixteenths].



*Certhiparus*, Mihi. [Olim *Minla*, Hodgson, *Ind. Rev.* 1838, p. 42; changed to *Proparus*, H., *J. A. S.*, X. 29, which latter name is now transferred to the preceding group.] Bill somewhat lengthened, slender, and inclining to arch, but the tip of the upper mandible strongly notched; base depressed; rictus moderate and nearly smooth. Nares large, advanced, tenuirostral; the aperture lunately lineated by a large and soft incumbent membrane: tongue simple, forked. Wings round, acuminate; fifth longest, the first and second much, the third and fourth less, gradated. Tail medial or short, and round with ovoid tips, the webs of which are open and harsh. Tarse equal only to mid-toe and nail: toes medial, compressed, very unequal, and basally much connected; the hind very large and alone exceeding the outer fore, but not broad, nor its nail so long as the digit: nails much curved and compressed.

Types *ignitinctus* and *castaniceps*, Mihi.

*C. ignitinctus*. [*Minla ignitincta*, Hodgson, *Ind. Rev.* 1838, p. 32; *Leiothrix ornata*, McClelland and Horsfield, *Proc. Zool. Soc.* 1839, p. 162.] Head and neck black and white in broad alternate masses; the crown, and a line through the eye from the bill, black; and a broad superciliary space, with the throat, white: mantle luteous-olive merged [in the male?] in vinous across the upper back: body below yellow [or yellowish:] alars and caudals black; prime alars and caudals margined and tipped crimson; the rest white-edged: legs horn-yellow; bill black above, horn below. Female less in size and duller-hued. Length five inches and a quarter; bill ten-sixteenths of an inch; tail two inches and a quarter; wing two and five-eighths; tarse thirteen-sixteenths; central toe and nail three-fourths of an inch; hind ten-sixteenths. [Occurs also in Assam.]

*C. castaniceps*. [*Minla castaniceps*, Hodgson, *Ind. Rev.* 1838, p. 33.] Above olive, with a bright chesnut cap streaked with white; below lutescent: ears and moustache black; centre of alars margined with rusty; outer primaries with hoary: legs fleshy; bill dusky-horn. Length five inches; bill nine-sixteenths of an inch: tail an inch and thirteen-sixteenths; the wing two and a quarter; tarse seven-eighths of an inch; central toe and nail eight-sixteenths, the hind nine-sixteenths of an inch. Somewhat deviates by its straighter bill and shorter narrower tail with wedged tips, but has the *quasi*-Certhian feet with large compressed

thumb exceeding the outer fore, and *with its nail* nearing the central. [It is by no means nearly allied to the preceding species.]

The curious will find all these birds carefully described, long ago, in the 'India Journal of Science'; but the subject is worth recurring to, and is attempted to be treated now so as to shew more accurately the curious gradation of form. In this rich accession to the *Leiotrichanæ* of Swainson, we have great means of illustrating that family, which seems to be a singular combination of *Parus* with the long-legged Finches on the one hand, and the Certhians on the other. The structure and habits, on the whole, are nearer to *Parus*, into which genus our *vinipectus* passes almost absolutely. Others remind us by their short toes of *Iora*, *Zosterops*, and the clinging *Brachypodans*; while the Certhian structure is represented very fully in the bill and feet of *ignitinctus*, and less palpably yet distinctly so in its tail; and the tails of *vinipectus* aforesaid, as well as of *nipalensis*, are of the scansorial model.

*Leiothrix* as a genus may embrace the whole; but I think the *quasi*-Finch—*argentauris*, the *quasi*-Ioran or short-toed, and the *quasi*-Certhian,—forms, deserve at least subgeneric separation. Indeed how could one define them in a single genus? All these birds are foresters, and more or less gregarious: their food consists almost equally of hard grass-seeds and small grains (wherein they resemble the Finches), and of hard and soft, perfect and imperfect, insects (wherein they agree with *Parus*;)\*) and the character of the stomach and intestines is of a mixt type, between the typical Finches and the Tits.

They creep and climb among foliage and large flowers, and the Finch-like ones perch on the standing stalks of large grasses and small grains, just like the Carduelines. These (*Philocalyx*) are the greatest seed-eaters, and the *Certhipari* the least so, the latter being admirable climbers. They make half pensile semi-globular nests, well compacted, and placed at a moderate height on umbrageous trees or large shrubs in the forests, and are all confined to the northern and central hilly regions [of Nepal], being very rare in the southern hilly region, and wholly unknown to the plains. The thick-billed Finches and Tits have

\* The true *Pari* devour oleaginous seeds with avidity; piercing a hole, for example, in the husk of a hemp-seed, and thus extracting the kernel: and I have remarked that *P. ater* and *P. palustris* of Europe are very partial to sunflower-seeds.—E. B.

mostly the same location ; but some of both of these are found in the lower hills and plains, especially of the Finches, as the *Tooti* or Rosy Finch [*Erythropsiza erythrina*], which, by the way, seems to me a distinct type leading from *Pyrrhula* to *Linota*.\* The *Gandums* or Buntings are likewise found in the plains ; though there the European [forms of] Finches are properly represented by the Weavers, and the Amadines,—the *Bayas* [*Ploceus*, v. *Euplectes*, Sw.], *Lauls* [*Estrela amandava*], *Moonias* [*Amadina*, v. *Lonchura*, Sykes, v. *Munia*, Hodgson], &c. of Indian speech.

*Emberizæ* are commonly hill birds, and *Pari* almost, or quite, exclusively so. I have four species of the former and twelve of the latter genus !

May, 1843.

P. S.—Adopting Swainson's views, one might justify the above division of our Leiotrichane birds by shewing that they form a circle analogous to the various tribes of the *Insesores*, thus :—

Tribes of <i>Insess.</i>	Analogical characters.	{ Genera and subg. of <i>Leio-</i> <i>trichanæ</i> .
<i>Conirostres.</i>	{ Wings and feet perfect. Food various.	{ <i>Fringilliparus</i> . [ <i>Mesia</i> .]
<i>Dentirostres.</i>	{ Wings rounded. Insects chiefly.	{ <i>Leiothrix</i> . [olim <i>Bahila</i> , H.]
<i>Fissirostres.</i>	Feet imperfect.	<i>Hemiparus</i> . [ <i>Siva</i> .]
<i>Tenuirostres.</i>	{ Bill slender, curved, large soft nares.	{ <i>Certhiparus</i> . [ <i>Minla</i> .]
<i>Rasores, or Scan-</i> <i>sores.</i>	{ Bill entire, short ; tail ri- gid ; hallux enlarged.	{ <i>Proparus</i> .

At least it will be allowed to be pretty evident that *Certhiparus* is the analogue of *Mniotilta*, and *Hemiparus* of *Zosterops* ; but as Swainson has made these respectively the scansorial and suctorial types, the above distribution is probably in fault, and in fact is but a hasty glance of the subject in *this* view, which is purely theoretical and perhaps unsound. [The decidedly Leiotrichane genus *Pteruthius* is here omitted altogether, though composed of two Himalayan and Nepalese species, viz. *Pt. rufiventer*, nobis, *J. A. S.* XI, 183, and XII, 854, and *Pt. erythropterus*, v. *Lanius erythropterus*, Vigors, and of Gould's 'Century,' noticed also in XI, 183.]

\* This bird is perfectly true to the form of the American *Purple Finch* of Wilson, which is the type of *Erythropsiza*, Bonap.: the group consisting of *Linnets* with tumid bills, in which respect alone they appear to me to approximate to the Bullfinches.—E. B.

The *Leiothrix signata*, McClelland and Horsfield, *Proc. Zool. Soc.* 1839, p. 162, is identical with *Siphya auricularis*, (Hodg.) Blyth, *J. A. S.* XII, 940, and must accordingly now range as *S. signata*.

Another Himalayan bird referred to the *Leiotrichanæ* by Mr. G. R. Gray, in the 2d edition of his 'List of the genera of Birds' (p. 45), is *Sylviparus modestus*, Burton, *Proc. Zool. Soc.* 1835, p. 154;\* but I suspect the identity of this with a species sent as a *Parus* by Mr. Hodgson, and which does not appear to me to differ in any marked degree from *Parus*, further than in its style of colouring, and in having a shorter tail. The generic diagnosis supplied by Mr. Burton accords with the species in question, except that the expression "*rostrum brevissimum*" conveys the idea of a still shorter bill than occurs in the bird before me, of which I draw up the following description:—

*Sylviparus modestus* (?), Burton, *loc. cit.*; *Parus seriophrys*, Hodgson, *MS.* Length about three inches and five-eighths, of which the tail measures an inch and three-eighths; wing two inches and one-eighth; bill to gape three-eighths; tarse nine-sixteenths of an inch. (*S. modestus* is stated to measure four inches, of which the tail occupies an inch and a quarter; and tarse half an inch.) Colour that of the *Phylloscopus* group, or olive-green above, paler and dingy below; the base of the primaries externally edged with yellowish-white: head distinctly crested. Nepal.

Of the remaining eleven species of *Parus* alluded to by Mr. Hodgson, four are figured in Gould's 'Century of Himalayan Birds,' viz.

*P. monticolus*, Vigors, *P. Z. S.* 1831, p. 22.

„ *xanthogenys*, *Ibid*, p. 23.

„ *melanolophus*, *Ibid*.

„ *erythrocephalus*, *Ibid*.

\* Other species described at the same time were *Athene* (v. *Noctua*) *Brodiei* = *Ath. tubiger*, (Hodgson,) *As. Res.* XIX, 175, and *J. A. S.* XI, 163; *Phanicura McGregorii* = *Niltava fulgiventis*, H., *Ind. Rev.* 1837, p. 650; *Sylvia*? *castaneo-coronata* = *Tesia flaviventis*, H., *J. A. S.* 1837, p. 101; *Sylvia Burkii* = *Culicipeta Burkii*, Nobis, *J. A. S.* xii, 968, v. *Muscicapa bilineata*, Lesson, v. *Cryptolopha auricapilla*, Sw. (*Menag.*); *Ægitalus flammiceps*, probably a *Stachyris*, *J. A. S.* XIII, 379; and *Picumnus innominatus* = *Vivia nipalensis*, H., *J. A. S.* VI, 107, and XII, 1005. To *Tesia cyaniventis*, H., must be referred *Saxicola*? *olivea*, McClelland and Horsfield, *Proc. Zool. Soc.* 1839, p. 161; and there is an Abyssinian species of this group figured as *Troglodytes micurus*, by Ruppell.



Others are described by Mr. Hodgson in the 'India Review' for 1838, p. 37 : viz.

*P. atriceps*, Horsfield, v. *P. nipalensis*, H., which, with *P. xanthogenys* and *P. melanolophus*, extends into the hill regions of Southern India, the present species likewise occurring in the Malay countries.

*P. sultaneus*, Hodgson, v. *Melanochlora flavocristata* and *M. sumatrana*, Lesson and La Fresnaye, vide *J. A. S.* XII. 955 : a remarkable species which also extends into the Malay countries.

And the following may now be added :—

*P. dichrous*, Hodgson. Length about five inches ; of wing two and a quarter, and tail an inch and seven-eighths ; bill to forehead under three-eighths of an inch ; tarse three-quarters of an inch. Upper-parts uniform brownish-grey, the occiput adorned with a slightly recurved crest of unpointed feathers, nearly an inch long ; entire under-parts dull rufescent-brown, the forehead and cheeks tinged with the same : bill dusky ; and feet lead-coloured. Nepal.

*P. æmodius*, Hodgson. Very closely allied to *P. ater*, but the bill decidedly more slender and compressed ; the black also descends more upon the breast, and spreads laterally, circumscribing the sides of the neck ; and the back is less tinged with olivaceous, while the belly would appear to be more rufescent, than in its European representative. Nepal.

*P. iouschistos*, Hodgson. Length about four inches and a quarter, of which the tail measures two inches, and has its outer three feathers graduated, and the middle pair a quarter of an inch shorter than the next ; wing two inches and one-eighth ; bill to forehead, through the feathers, three-eighths of an inch ; tarse five-eighths. Colour ashy above, tinged with olive, the winglet and coverts of the primaries black ; a very broad black streak over each eye (as in *Orites caudatus*), and the central line of the head, with the sides of the head and entire under-parts, clear red-dish-isabelline ; graduated outer tail-feathers more or less tipped and edged externally with whitish : bill black ; and feet pale brown. Nepal.

The last species, with *P. erythrocephalus*, should perhaps be rather arranged in *Orites* vel *Mecistura*, but *P. iouschistos* has a longer and more *Parus*-like bill, and both serve to connect *Orites* with *Parus* by an easy gradation. The European *Orites caudatus* differs much in habit from the true *Pari*, being exclusively insectivorous, and also never placing its foot upon its food while picking it to pieces with the bill in the

Jay-like or Crow-like manner continually resorted to by the true *Pari* ; and it is likewise celebrated for its beautifully constructed large domed nest, which is placed in a forked branch, whereas the *Pari* nidificate in holes and cavities : but I remember M. Audubon telling me, that he had discovered some cases of intermediate habit even in this particular, one or two North American species constructing a regular domed nest with inside a suitable cavity in a tree ; and the same is not unlikely to be the case with these two Himalayan species.

The above ten species of Himalayan *Pari* (apud Hodgson,) are all which I am acquainted with at present ; but there is a “ *P. (?) minutus*,” Jerdon, of Southern India, described by the latter naturalist, which appears to have the plumage of *Sylviparus*, but of which “ the bill is larger, and less robust, than in the Tits, in general approaching that of *Ægithalus*.” *Madras Journal*, XI, 8. (*Non vidi*.)

I was next about to endeavour to indicate Mr. Hodgson’s four *Emberizæ* ; but as I dislike giving isolated notices, I will venture to offer a general

#### SYNOPSIS OF INDIAN FRINGILLIDÆ,—

Which will afford the opportunity of making known several new species discovered by Mr. Hodgson, and be far more acceptable to the Ornithologist than an indiscriminate medley of previously undescribed species.

To begin with the genus *Ploceus* (v. *Euplectes*, Sw.), three species of which are common in Bengal and respectively more or less so in other parts of India.

1. *Pl. philippinus* (?); thus marked with doubt because there is reason to suspect its distinctness from its representative in the Philippine Islands, or *Loxia philippina*, Lin., founded on the *Grosbec des Philippines* of Brisson, or *Toucnam-courvi* of Buffon (*Ois.* III, 462) : the latter author refers to Brisson for a description of the male ; but in his notice of the *Baglafecht* of Abyssinia (*Pl. baglafecht*, Vieillot, *Loxia philippina*, var, Lath.), he alludes to a black spot on each side of the head of the Philippine species, which certainly does not apply to the

Indian bird under consideration (some notice of which occurs in *J. A. S.* XI, 872). *Pl. philippinus* is included among the birds of Sumatra by Sir S. Raffles, and among those of Java by Dr. Horsfield; but in a recent communication Mr. H. E. Strickland informs me, that “the *Fringilla philippina* of Dr. Horsfield’s catalogue is not the true *philippina*, but I have not yet decided,” he adds, “what it is.” Hence I suspect that the Javanese bird will prove to be the original *philippina*, rather than the allied Indian species, which latter has always been so designated, and is probably thus alluded to by Mr. Strickland as the “true *philippina*.” Should it require a name, it might be termed *Pl. baya*. It extends its range throughout India, and is the only species of the genus which Mr. Hodgson has forwarded from Nepal.\*

2. *Pl. manyar*; *Fringilla manyar*, Horsf., *Lin. Tr.* XIII, 160, apud Strickland in *epistola*: *Euplectes flaviceps*, Swainson, *Menag.*, and probably *Ploceus flaviceps*, Cuv., *Par. Mus.*, as mentioned in Lesson’s *Traité*; (nec *Pl. flaviceps*, Sw., which now ranks as *Hyphantornis stictonotus*, (A. Smith) G. R. Gray;) *Euplectes striatus*, Nobis, *J. A. S.* XI, 873, and XII, 181 (*bis*); and probably *Coccothraustes chrysocephala*, Vieillot, which is referred to the next species in the *Dict. Class. W.* India, Bengal, Assam and Malay countries. Constructs a non-pensile nest among reeds, with an incipient tubular entrance; as I am informed is also very commonly the case with the preceding species, when resorting to similar localities.

3. *Pl. bengalensis*; *Loxia bengalensis*, Lin. (founded on the *Yellow-headed Indian Sparrow* of Edwards): *L. regina*, Bodd.; *Euplectes albirostris*, Sw. *Menang.*—Bengal; less common in S. India.

Next to the Baya or Weaver group (so largely developed in Africa) may be arranged the Sparrows:—

\* A letter just received from Mr. Strickland informs me, that—“Horsfield’s so called *Pl. philippinus* from Java, is bright yellowish above, back striped with dusky; wings dusky, each feather margined whitish; tail dusky, narrowly tipped with whitish. Beak shorter than in *bengalensis*, the cheeks and throat blackish with a yellow streak dividing that on the lower jaw. Lower parts deep yellow. No doubt a well known species, though I cannot at the moment give the right name.”

1. *Passer domesticus* (?), Lin. ; *P. indicus*, Jardine and Selby, *Ill. Orn.*, 1st. series, pl. CXVIII. I have had no opportunity of comparing European and Indian specimens of the common Sparrow of the respective regions ; but it has always seemed to me, judging from recollection, that the upper parts of the male are somewhat redder, the under parts whiter, and that the females are decidedly paler altogether, in the Indian than in the British Sparrow : but the Indian bird certainly is not "smaller in all its proportions," as stated by Messrs. Jardine and Selby ; nor are the upper parts of the male nearly so red as represented in their plate. The common Sparrow of India is generally distributed over the country, even in the hottest districts ; and Mr. Crawford notices its abundance in the capital of Siam ; with "more than its European familiarity. In proceeding towards the equator," he adds, "it appears here for the last time, not to my knowledge being found in any Asiatic country to the south of Siam, except in a few spots where it has been introduced by Europeans." ('Embassy to Siam and Cochin China,' p. 432.)

2. *P. pyrrhonotus*, Nobis, *n. s.* Closely resembles the last in plumage, but is readily distinguished by its inferior size, its conspicuously smaller bill and feet, and by having the rump feathers dull maroon, instead of greyish-olive. Length about four inches and three-quarters, of wing two and five-eighths, and tail two and one-eighth ; bill to forehead five-sixteenths, and to gape seven-sixteenths of an inch ; tarse barely five-eighths, middle toe and claw five-eighths. Obtained, together with the preceding, at Buhawalpore, in Scinde, by the late Sir Alexander Burnes. The female I have not seen.

3. *P. flaveolus*, Nobis, *n. s.* With a close resemblance in its markings to the common Sparrow, except that the back is not streaked, this pretty species is distinguished by its smaller size and predominating yellowish plumage. The bill somewhat inclines to be slender, and in this respect, as well as in the absence of all streakiness above, some approach is shewn to *Gymnoris flavicollis*. In the male, the top of the head, nape, and rump, are of a dull light green, inclining to yellowish on the forehead ; the cheeks and sides of the forehead are tolerably bright yellow, and the rest of the under parts are sullied yellow : streak from eye to mouth, and the usual patch on the throat and fore-neck,



deep black : sinciput, mantle, and anterior third of wing, chesnut-bay, passing to maronne at the bend of the wing : there is a whitish bar on the wing, formed by the tips of the smaller range of coverts ; and the rest of the wing, with the tail, is dusky, the feathers margined with yellowish-brown. Bill black (in the breeding season) ; and legs brown. The female is nearly uniform pale brown above, darker on the mantle, and having the whitish bar on the wing somewhat narrower ; supercilium, cheeks, and under parts, dull yellowish ; and bill light brown. Length five inches, or nearly so ; of wing two and three-quarters, and tail two inches : bill to forehead seven-sixteenths, and tarse five-eighths. From Arracan, where procured by Capt. Phayre.

4. *P. pyrrhopterus* ; *Fringilla pyrrhoptera*, Lesson, *Zoologie du Voy. de M. Belanger*, p. 271. (*Non vidi*.) “ Size of the common Sparrow. Head and neck spotless rufous-brown ; the mantle bright rufous, with black central streaks to the feathers ; shoulder deep maronne, bordered by a small oblique white line ; the middle wing-coverts black, edged with rufous and maronne, and the rest of the wing pale ashy externally, and brownish on the inner barbs of the feathers : under parts rufous-grey, the throat reddish-grey, with a black patch commencing on the lower part of the neck : bill and tarse yellowish [but the former doubtless black during the breeding season as in the other species]. Female grey-brown, above silky, with brown central streaks to the feathers of the mantle ; below of a blonde-grey throughout : wings ash-grey with a white ray on the shoulder, but no maronne.” Described to inhabit the Coromandel coast, and especially the neighbourhood of Pondicherry ; but the species has not been obtained by Mr. Jerdon.

5. *P. cinnamomeus* ; *Pyrgita cinnamomea*, Gould, *Proc. Zool. Soc.* 1835, p. 85, and noticed in *J. A. S.* XI, 108. Inhabits the Upper Provinces of Hindoostan.

6. *P. montanus* ; *Fringilla montana*, Lin. This British species is common in the Himalaya, and extends eastward to China and Japan : it takes the place of the common Sparrow in Chusan. But a more unexpected locality for this bird to inhabit, is the island of Ramree, Arracan, whence fine specimens have been forwarded to the Society by Capt. Abbott. This Sparrow is remarkable for the female and young resembling the adult male in plumage, all being clad in a dress analogous in colouring to that of the adult males only, of the other species.

7. *P. (?) concolor*, Jerdon, *Madr. Journ.* XI, 28: perhaps *Emberiza olivacea*, Tickell, *J. A. S.* II. 578, which specific name would have the priority. (*Non vidi.*) According to Mr. Jerdon, this bird "does not exactly agree with the characters of *Pyrgita* [*i. e. Passer*], having the bill more turgid, and with the commissure slightly sinuated. The third quill is shorter than the two first, and the inner toe is shorter than the outer one; its claws moreover are less curved. Colour uniform light ash-brown above, still paler below (indeed almost white at chin and vent), and darkish on the quills and tail. Length six inches; wing three inches and three-eighths; tail two and a quarter: tarse rather more than seven-tenths; bill at front four-tenths. Irides brown: bill brown above, yellowish below; legs flesh-coloured yellow." The only specimen obtained by Mr. Jerdon was shot on the ground in an open plain, along with a lot of the *Coryphidea baghaira*, p. 961 Hab. S. India.

*Gymnoris*, Hodgson, *n. g.* Differs from *Passer* in having the beak more elongated, slender, and *Carduelis*-like; it being more slender than in restricted *Fringilla*.

*G. flavicollis*; *Fringilla flavicollis*, Franklin, *P. Z. S.* 1831, p. 120; referred to *Ploceus* by Col. Sykes, *P. Z. S.* 1832, p. 94, and with more propriety to *Pyrgita* vel *Passer* by Mr. Jerdon.\* India generally, though

\* Mr. Strickland remarks, in his recent letter to me, "I consider *Fringilla flavicollis* to be a true *Passer*. It is one of the many instances, among the *Fringillidæ*, of the variable amount of development of the beak in the same genus. Its style of plumage is completely that of *Passer*, and the yellow spot on the throat resembles that of *Fringilla petronia* which I also consider a *Passer*. *Fringilla flavicollis* is certainly not a *Plocepasser*, wanting the spurious quill found in all the *Ploceinæ*; still less is it a *Ploceus*." To this may be added that its nest and eggs, as described in Mr. Jerdon's catalogue, are quite those of *Passer*, the former being widely different from that of *Plocepasser*. Mr. G. R. Gray, however, in his illustrated work on the genera of birds, now in course of publication, includes this bird among the species of *Ploceus*, following Col. Sykes, and he also refers to *Ploceus* the *Fringilla erythrocephalus*, Gm., which is decidedly a *Hyphantornis*, G. R. Gray (*v. Ploceus* apud Swainson); there is some considerable difference between the beaks of either of these species and that of *Pl. capensis*, which deviates in the opposite manner from the type of *Ploceus*: still I agree with Mr. Strickland in his appreciation of the systematic value of various strongly marked modifications of the beak, observable in several natural divisions among the *Fringillidæ*, and indeed have expressed my opinion on the subject in the course of the present paper. Had Mr. Hodgson not separated *Gymnoris* from *Passer* as above, I should scarcely have myself ventured upon doing so.

I have not hitherto met with it in Lower Bengal. Mr. Hodgson obtained it in Nepal, and Sir A. Burnes in Scinde.

I next pass to the Mooniahs,—*Amadina*, Swainson, v. *Lonchura*, Sykes, v. *Loxigilla* (in part), Lesson, v. *Munia*, Hodgson; *Spermestes*, Swainson, apud Jerdon.

1. *A. malacca*; *Loxia malacca*, Lin.: *Munia rubronigra*, Hodgson, *As. Res.* XIX, 153; *Lonchura melanocephala*, Horsfield, *P. Z. S.* 1839, p. 163. Common throughout the country.

2. *A. maja*; *Loxia maja*, (nec *Fringilla maja*,) Lin.; *Malacca Grosbeak*, Edwards. I include this species on the authority of Mr. Frith, who assures me that he has now and then observed it in different parts of Bengal, but not commonly, nor in large flocks like the others, two or three only having been seen by him together. It is common in the Malay countries.

3. *A. pectoralis*, Jerdon, *MS.*; *Spermestes*, No. 103 (*bis*), *Madr. Journ.* No. XXX, p. 171. South of India.

4. *A. acuticauda*; *Munia acuticauda*, Hodgson, *As. Res.* XIX, 153. Nepal.

5. *A. striata*; *Loxia striata*, Latham: *Fringilla leuconota*, Tem. Indian peninsula; Arracan.

6. *A. punctularia*; *Loxia punctularia*, Lin.: *Fringilla nisoria*, Tem.; *Munia lineoventer*, Hodgson, *As. Res.* XIX, 154. Common throughout the country.

7. *A. malabarica*; *Loxia malabarica*, Lin.: *Lonchura cheet*, Sykes, *P. Z. S.* 1832, p. 95; *Loxia bicolor*, Tickell, *J. A. S.* II, 578. Also generally diffused.

*Estrela*, Swainson; *Loxigilla* (in part), Lesson. The Waxbills. Of this extensive genus, I know only of two Indian species, which are by no means closely allied.

1. *E. amandava*; *Fringilla amandava*, Lin.: *F. punicea*, Horsf., *Lin. Trans.* XIII, 160. Occurs in enormous flocks in many parts of the country.

2. *E. formosa*; *Fringilla formosa*, Lath. Central India.

The foregoing three groups, — of Weaver-finches, — of Sparrows, — and of Mooniahs, Amaduvats and Waxbills, — are very distinct from any of the following genera, and appear to me to range most naturally

in the order in which I have placed them.\* We now come to the more typical Finches, which have endless mutual affinities, and are most difficult to arrange in anything like a satisfactory series.

*Coccothraustes*, Brisson. Grosbeaks. The three Himalayan species are remarkable for their black and yellow plumage, in which respect, and perhaps others, they approximate the *C. vespertinus* of North America. Each of them, however, presents peculiarities in the modification of the beak, and each likewise differs in the character of plumage proper to the female sex.

1. *C. melanozanthus*, Hodgson, *As. Res.* XIX, 150: male figured in Mr. G. R. Gray's illustrated work on the genera of birds, but the beak made to appear too much elongated, the colour of the upper parts too black, and the tail too much truncated. As compared with the European *C. vulgaris*, the beak is not longer, but is much broader, and more bulged (or *Pyrrhuline*), and the basal denticulation of the upper mandible is strongly developed. It is probably the largest Finch in existence.

2. *C. carnipes*, Hodgson, *As. Res.* XIX. 151. The beak of this fine species approaches to the *Pyrenestes* form, being much less bulged than in the preceding, and a good deal compressed towards the tip; the basal denticulation very decided.

3. *C. icterioides*, Vigors, *P. Z. S.* 1831, p. 8; Gould's 'Century', pl. XLV. Beak more elongated than in the others, or rather more drawn out towards the tip; and approaching most nearly in form to that of *C. vulgaris*. This species would seem to be allied to the Chinese *C. melanura*.

*Hæmatospiza*, Nobis, *n. g.* Bill nearly as in *Guiraca*, Sw., or *Pyr-*

\* Mr. Strickland remarks, in *epistolâ*,—"An excellent distinction between the *Ploceinæ* and *Fringillinæ* was pointed out by Swainson, viz. the spurious quill in the former, wanting in the latter. On this ground I refer all the *Amadina* tribe (which possess this quill) to the *Ploceinæ*." The character here mentioned would retain the Sparrows with the *Fringillinæ*, and it seems to hold good throughout the two groups: but the *Alaudinæ* vary in this respect, as the spurious quill occurs in *Mirafra*, in *Pyrrhulauda*, and also in *Cethilanda*, while it is absent in all or most of the rest. I cannot, however, quite agree with Mr. Strickland in referring the *Amadina* series to the *Ploceinæ* as a major division, but would retain it as a distinct and corresponding supergeneric group; and I much incline to the same opinion, as regards the separation of both the Sparrows and the Buntings from the *Fringillinæ*.



*rhuline* in form, but more elongated, the tip of the upper mandible curving distinctly downward over the lower, with a minute but distinct notch at the bend : wings as in *Corythus*, reaching to the middle of the rather short tail : feet adapted for arboreal habits.

*H. boetonensis* ; *Loria boetonensis*, Lath. :\* *L. indica*, Gm., nec Lath. : *Corythus sepahi*, Hodgson, *As. Res.* XIX, 151. Himalaya, Examples of this brilliant species are now and then brought for sale to Calcutta. I suspect that it is allied in form to *Guiraca ludoviciana*.

*Pyrrhula*, (Antiq.) Mæhring. The Bullfinches.

1. *P. nipalensis*, Hodgson, *As. Res.* XIX, 155. Himalaya.

2. *P. erythrocephalus*, Vigors, *P. Z. S.* 1831, 174 ; Gould's 'Century,' pl. XXXII. Himalaya.

*Pyrrhuloides*, Nobis, *n. g.* This curious form connects the *Pyrrhuline* with the Bunting form of bill, and presents some appearance of an affinity with the *Ploceus* group. As viewed from above, the beak is bulged as in *Pyrrhula*, but not quite so short and broad ; and the lateral aspect is that of a stout *Emberiza* bill, having the tomixæ of the mandibles much inflected, and the upper one similarly scooped, while the lower is proportionably thickened : the tip of the upper a little overhangs that of the lower mandible : nostrils basal, and concealed by short reflected plumes. Wings of mean length, having the second, third, and fourth primaries subequal and longest. Tarse as long as the middle toe, the feet formed for perching, the two lateral toes nearly equal, and the claws moderate, the anterior somewhat straight.

*P. epauletta* ; *Pyrrhula epauletta*, Hodgson, *As. Res.* XIX, 156. Of this species I took the following description from specimens taken to England by Mr. Hodgson. Male wholly brownish-black, excepting an orange or golden-saffron patch occupying the posterior half of the crown with the occiput, and the axillary plumes under the wing which are similarly coloured. Female spotless reddish-brown, brightest on the belly and flanks, greater wing-coverts, and tertiaries ; the forehead and neck grey ; coronal patch, with the ear-coverts, dull greenish-saffron ; axillaries as in the male ; primaries and tail dusky ; and the inner webs of the uppermost tertiaries are more or less white, a trace of which also occurs in the male. Bill of both dusky-horny, and feet

\* Probably meant for *bootanensis*, or *bottanensis* as more elegantly rendered.

brown. Length about five inches and three-quarters, of wing three inches, and tail two and a quarter; bill to forehead seven-sixteenths of an inch, and tarse eleven-sixteenths. Himalaya, and I believe rather uncommon.

*Propyrrhula*, Hodgson, MS. This connecting form has the beak of a true *Pyrrhula*, though not quite so short as in *P. vulgaris* and *P. erythrocephalus*; while the plumage and colouring ally it to *Corythus* and *Erythrospiza*, the former being, however, a degree less firm, wherein it approximates the true *Pyrrhula*. It can only be arranged satisfactorily as a separate division.

*P. subhemachalana*; *Corythus subhemachalus*, Hodgson, As. Res. XIX, 152. Himalaya.

From *Propyrrhula* the genus *Erythrospiza* would conduct us by an easy gradation to the Linnets and allied forms; but the remarkable genus *Corythus* branches off from the present group, and leads us direct to the very curious group of Crossbills, *Loxia*, of which *L. curvirostra* occurs in Afghanistan, and the following new species in Nepal:—

*L. himalayensis*, Hodgson, MS. Distinguished from *L. curvirostra* by its very inferior size, being smaller than *L. leucoptera*; the bill also is as slender as in *Carduelis*, but deeper in conformity with the generic characters of the Crossbills. Length about five inches and a half, of wing three to three and a quarter, and tail two inches; bill (in a straight line) half an inch. Plumage as in *L. curvirostra* and *L. pytiopsittacus*.

*Erythrospiza*, Bonap.; *Hæmorrhous*, Swainson. The birds of this division are essentially Linnets with more or less tumid bills.

1. *E. erythrina*, (Pallas): *Coccothraustes rosea*, apud Vieillot; described as "*E. rosea*?" in J. A. S. XI, 461. India generally, being the only representative of the present great series of northern Finches upon the plains of India.

2. *E. rodopepla*; *Fringilla rodopepla*, Vigors, P. Z. S. 1831, p. 23; male figured in Gould's 'Century,' pl. XXXI, fig. 1 (the lower figure in the plate). Bill less *Pyrrhuline* than in the preceding species, more so than in the next. Length about six inches and three-quarters, of wing three and one-eighth, and tail two and three-quarters. Female rather less; her colour deep brown above, with paler lateral

margins to the feathers; below light yellowish-brown, each feather with a dark central line; a broad pale supercilium reaching to the occiput, and another pale line from the base of the upper mandible. Himalaya:

3. *E. rodochroa*; *Fringilla rodochroa*, Vigors, *P. Z. S.* 1831, p. 23; male figured in Gould's 'Century,' pl. XXXI, fig. 2, but the middle of the crown erroneously represented as of the same pale rosy colour as the eye-streak and a slight frontal band. Beak scarcely more bulged than in *Linota cannabina*, and chiefly so as viewed from above. Length about five inches and three-quarters, of wing two and three-quarters, and tail two and three-eighths. Female paler and more decidedly streaky than that of the last species, especially paler upon the rump and upper tail-coverts, and with the light supercilium much less distinct and contrasting with the feathers above and below it: in the female of *E. rodopepla*, these last are dark and contrast strongly with the broad pale supercilium. Himalaya.

We might next pass to the Linnets; but there is a long-winged and more terrene form, with narrower and more elongated beak than in the last, which cannot be introduced better than in this place, and which constitutes the division.

*Pyrhospiza*, Hodgson, *MS.* Bill conical, elongate, with a slightly curved outline above and below, somewhat compressed, and tapering evenly to the tip as viewed from above; the gonys arched: wings long, reaching to more than half the length of the tail, which is also moderately long; the first four primaries subequal, the second and third being rather the longest. Feet adapted for ground habits, the toes rather long, with large and arched claws, especially that on the hind-toe.

*P. punicea*, Hodgson, *MS.* Length about seven inches and a half, of wing four and a half, and tail three and one-eighth; bill to forehead five-eighths of an inch, tarse seven-eighths, middle toe and claw an inch, hind toe three-quarters of an inch: upper-parts nearly uniform dusky-brown, the feathers margined paler; forehead and rump, with the cheeks, ear-coverts, and the under-parts excepting the abdominal region, roseate in winter, brightening to rich crimson in the breeding season, and varying to orange-saffron\*; flanks and abdomen coloured

\* A variation more or less frequent in the species of *Loxia*, *Corythus*, *Propyrrhula*, *Erythropsiza*, *Linota*, &c.

like the back; bill dark horny, and feet dusky-black. Female devoid of the red, having the forehead, cheeks, fore-neck, and breast, more or less fulvescent, each feather marked with a blackish mesial streak, widening at the tip; belly and lower tail-coverts dingy. Himalaya.

A second species of this division not improbably exists in the *Fringilla sanguinea* of Gould, *P. Z. S.* 1837, p. 127, received from Erzeroum. The form would seem allied to *Montifringilla* of Brehm, and holds the same relationship to the *Erythrospiza* group, which *Montifringilla* does to the restricted *Fringillæ*, as exemplified by the British Chaffinch and Bramble-finch. The next is an analogous long-winged modification of the true Linnets.

*Fringillauda*,\* Hodgson, *As. Res.* XIX, 158. This may be described as a Linnet with very long wings and tail, and somewhat elongated beak. The plumage is remarkable for the absence of any rosy colouring.

*Fr.* (v. *Montifringilla* ?) *nemicola*, Hodgson, *loc. cit.* Himalaya.

*Procarduelis*, Hodgson, *MS.* If the *Erythrospiza rodochroa* approaches so closely to the true Linnets that it might even be classed with them, did not the division *Erythrospiza* exist to claim it as an aberrant member, so the present form might include the sub-division of Redpole Linnets (*Rubricapilla* of Brehm,) were it not that this falls better under true *Linota*, as exemplified by *L. cannabina*, which again is directly connected with the Redpoles by the intervention of *L. montium*. The present form is indeed an *Erythrospiza* with a slender *Carduelis* bill, and exhibiting a marked affinity for the Redpole Linnets; but it will not bear to be admitted into either of the established subdivisions.

*Pr. nipalensis*; *Carduelis nipalensis*, Hodgson, *As. Res.* XIX, 157: *Linota saturata*, Nobis, *J. A. S.* XI, 192. The *Linota fusca*, Nobis, *ibid.* p. 193, so nearly approximates to the female of the present species, to judge from my description of it, that I shall here provisionally refer it to *Pr. nipalensis*, although my impression (from recollection) still is that it constitutes a distinct species, referable to true *Linota*: this question must remain in abeyance until the *L. fusca* can be verified on additional specimens.

*Carduelis*, Stephens. The Goldfinches. I have been assured that

\* Spelt *Fringalanda* in the original, evidently a mistake.



as many as three species of true Goldfinches, allied to the European species, and similarly adorned with crimson around the base of the beak, inhabit Chinese Tartary, and at least one I believe occurs at Darjeeling; but I have never chanced to see either species in any collection from the Himalaya, though the two following are described to inhabit the range.

1. *C. caniceps*, Vigors, *P. Z. S.* 1831, p. 23; Gould's 'Century,' pl. XXXIII, fig. 1, and more correctly represented in Royle's 'Illustrations of the Botany &c. of the Himalaya mountains,' pl. VIII; Gould's figure being much too dark, and, together with that of Royle, having the wings too short, and the fore-neck and breast too uniformly embrowned, at least than in an Afghan specimen from which I took the following description.—“ Differs most obviously from *C. communis* in the absence of any black upon the head, excepting between the bill and eye. Length about four inches and three-quarters, of wing three and a quarter, and tail two and one-eighth; bill to forehead five-eighths, and tarse half an inch. Upper-parts light greyish-brown, greyer on the head and neck; band crossing the front of the neck, with the sides of the breast, the same: forehead and around the bill crimson; and wing black, marked with bright yellow, and with white on the extremity of the outer edge of the tertiaries, as in the European species; tail likewise similar to that of *C. communis*: the rump, upper and lower tail-coverts, belly, middle of breast, and around the crimson of the throat and sides of the head, are white: beak pale carneous with a black tip; and legs pale.”

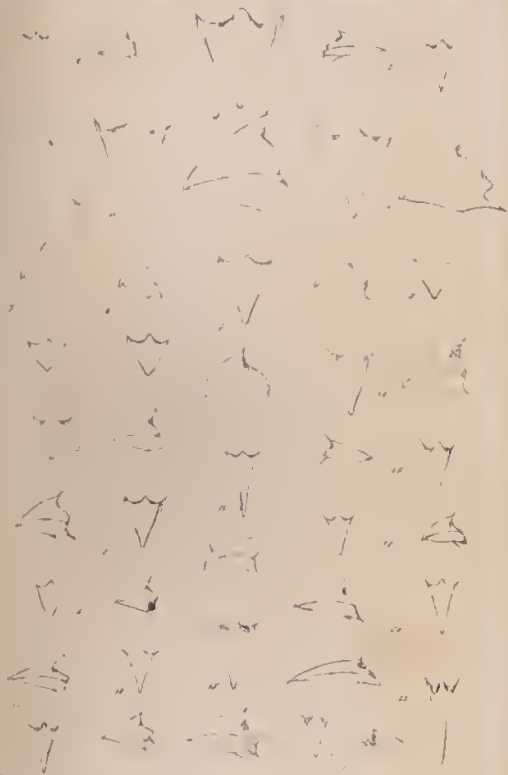
2. *C. Burtoni*, Gould, *P. Z. S.* 1837, p. 90. “ *C. fronte et regione circum-oculari pulchrè roseis; vertice genisque nigris; corpore obscurè fuscescenti-roseo, alis externè nigris, singulis plumis plus minusve albo ad apicem notatis; alâ spuriâ albâ; rectricibus caudæ nigris, duabus intermediis ad apicem albis, duabus proximis longius ad apicem albis, reliquis albâ notâ internè ad basin excurrente, ornatis; rostro, pedibusque pallidè fuscis. Long. tot.  $6\frac{1}{4}$  unc.; rostri  $\frac{5}{8}$ ; alæ  $3\frac{7}{8}$ ; caudæ  $2\frac{1}{2}$ ; tarsi  $\frac{3}{4}$ . Himalaya. This species departs in some respects from the other members of the genus, particularly in the robust form of the beak, which is slightly angulated at the base: the form of its wings and tail, together with their peculiar markings, however, clearly points out that it is only an aberrant species of that group.”*

*Chrysomitris*, Boie. The Siskins. The only Himalayan Siskin I know, like the Goldfinch last described, is remarkable for its thickened beak, approximating it to *Ligurinus*, Brisson, or the Greenfinches; one species of which, inhabiting the western coast of S. America, the *L. xanthogrammica*, G. R. Gray, presents a close approach on the part of the Greenfinches to the Goldfinches, the Siskins, and also to the Linnets, the form of its beak scarcely differing from that of the Himalayan Siskin, or

*Chr. spinoides*; *Carduelis spinoides*, Vigors, *P. Z. S.* 1831, p. 44; Gould's 'Century,' pl. XXXIII, fig. 2.

With the Siskins I terminate the series of Indian true Finches; and next in succession would come the Greenfinches, which would bring us back to the Grosbeaks with which we commenced; but this circle might be formed quite as satisfactorily in various other ways, the transitional forms of the present series being so numerous and completely intermediate, that all minute classification of them must be, in various instances, more or less arbitrary. By way of assistance to the student, I annex a plate with representations of the beaks of most of the species here comprised: but it must be remembered that it is not the beak alone, but the *ensemble*, which is our guide in the systematic arrangement of the *Fringillidæ*. In various most natural minor groups of this family, the same variety of modifications of the bill present themselves again and again, even to the Bullfinch, Grosbeak, and Goldfinch, extremes of form; as is especially well exemplified by the very peculiar group of short-tailed Finches so extensively developed in the Gallapagos islands; and in the instance of the common northern Snowfleck (*Plectrophanes nivalis*) and the Alpine Snowfinch (*Montifringilla nivalis*), we find the closest approximation in general characters combined with a very striking diversity in the conformation of the beak, which in the one case is that of a Bunting, and in the other that of a restricted *Fringilla*; the affinity of the birds themselves being further manifested even by the seasonal changes of colour which take place in the beak, however dissimilar its form, for in both of these birds it turns quite black at the breeding season.\* Were we to follow the indications

\* Mr. Strickland, in his recent letter to me before referred to, alludes to "the many cases among the *Fringillidæ*, in which the form of beak must give way to the preponderance of other characters, and especially to the style of colours in the plu-



- [illegible]





furnished by the beak alone, we should have to arrange various most incongruous species together, which in their affinities are much further removed apart than are the Snowfleck and Alpine Snowfinch, with dissimilar beaks; but it will not do, on the other hand, to disregard important distinctions in the form of this part, even when the rest of the structure is in accordance, and hence it appears impossible to arrange into intelligible minor groups the enormous series of the *Loxia* and *Fringilla* of the old systematists, without recognising as many and as minute divisions as have been adopted in this synopsis. I now pass to the genus.

*Emberiza*. The Buntings: of which the Indian species are referred to a group, *Euspiza*, by Mr. G. R. Gray, consisting of the more slender-billed species generally; but the limits of which, apart from restricted *Emberiza*, I cannot at all recognise, and shall therefore retain them under the latter title.

1. *E. Lathamii*, Gray, *Zool. Misc.*, I, p. 2; *E. cristata*, Vigors, *P. Z. S.* 1831, p. 35; *E. subcristata*, Sykes, *P. Z. S.* 1832, p. 93, (the female); *E. erythroptera*, Jardine and Selby, *Ill. Orn.*, 1st series, pl. CXXXII; *E. nipalensis*, Hodgson, *As. Res.* XIX, 157: type of *Melophus*, Swainson. More elevated parts of India generally, but chiefly the Himalaya.

2. *E. melanocephala*, Scop.; *Fringilla crocea*, Vieillot; *Xanthornis caucasicus*, Pallas; *Emberiza granativora*, Menitries; *Tanagra melanicterica*, Guldenstadt. S. India.

3. *E. aureola*, Pallas; *Fringilla pinetorum*, Lepech.; *Emberiza sibirica*, Gm.\* Himalaya, Arracan.

4. *E. fucata*, Pallas; *E. lesbia*; apud Tem., nec Gmelin; *E. cia*, apud Jerdon, vide *J. A. S.* XI, 601. Bengal, Indian peninsula.

5. *E. icterica*, Eversm., apud G. R. Gray, who figures it as *Euspiza icterica*. Central and western India.

6. *E. flavicollis*; *Mirafra flavicollis*, McClelland and Horsfield, *P. Z. S.* 1839, p. 163, which species Mr. Strickland informs me pertains to the present genus. Assam.

7. *E. Buchananii*, Nobis; *Fringilla jamjohari*, Buch. Hamilton's draw-

ing, of which," he adds, "I know no more striking instance than the *Emberiza palastris* vel *pyrrhuloides* (though I see, Gray makes these into two species), the beak of which is wholly unlike that of an *Emberiza*, yet in all other respects the bird almost exactly resembles *E. scheniculus*."

\* I have copied the synonyms of *E. melanocephala* and *E. aureola* from Mr. G. R. Gray's work.

ings; probably *E. hortulana*, apud Sykes, *P. Z. S.* 1832, p. 93. Would appear to be closely allied to *E. hortulana*, but differs in having the head, neck, and streak descending from the lower mandible ash-grey instead of dull green. Indian peninsula.

8. *E. sordida*, Hodgson, *MS.* Presumed female about five inches and a half in length, the wing two and a half, and tail two and a quarter; bill to forehead nearly half an inch, and tarse three-quarters of an inch. General hue of the upper parts dull olive-greenish, the feathers of the crown and back partially tinged with rufous, having medial dusky streaks; alars and greater wing-coverts also margined with rufescent-brown, and the two greater ranges of wing-coverts tipped with dull whitish: throat, belly, and under tail-coverts, whitish-yellow, sullied on the breast, and marked with dusky streaks on the flanks and sides of the fore-neck: upper mandible and tip of the lower one dull horny, the rest pale; and legs also pale. Nepal. Described from a specimen taken to England by Mr. Hodgson.

The Indian Larks follow next, which are as follow:—

*Pyrrhulauda*, A. Smith. Of this African form, there is one common Indian species:—

*P. grisea*; *Alauda grisea*, Scopoli: *A. gingica*, Lath; *Fringilla crucigera*, Temminck. India generally.

*Mirafra*, Horsfield: the Agguns. The species of this genus vary considerably in the degree of thickness of the bill, and also in the length of the wings and relative proportion of the primaries; but the first quill is always short, though varying a good deal in development, and the second rarely equals the third. Those with shorter and more rounded wings are also of a thicker form and less active in their habits; while the others present a nearer approximation to the true Larks.

1. *M. assamica*, McClelland and Horsfield, *P. Z. S.* 1839, p. 162; described in *J. A. S.* XI, 199. Remarkable for its thick bill, and obese, squat figure. Wings moderately long, with the first primary an inch in length, or nearly so, the second a quarter of an inch shorter than the third, and the third, fourth, and fifth, equal and longest. Common in Bengal, Assam, and Nepal.

2. *M. erythroptera*, Jerdon, *MS.*; "*M. javanica* ?," Jerdon's Catalogue, *Madr. Journ.* XI, 33, and probably of Franklin's catalogue. This species a good deal approximates the *M. javanica*, Horsf., *Lin. Tr.*

XIII, 159, judging from the more full description of Dr. Horsfield's specimens by Stephens, in Shaw's 'Zoology': but the Javanese bird is stated to have "the greater portion of the outer tail-feather white, and the following is of that colour on its outer web only; whereas in the Indian bird the white is confined to the exterior web of the outermost feather. Length about five inches and a half, of wing three inches and one-eighth, and tail two and one-eighth; bill to forehead somewhat exceeding half an inch, and tarse three-quarters: the outermost primary seven-eighths of an inch long, and second an eighth shorter than the third, fourth, and fifth, which are equal. Upper-parts streaky, the centres of the feathers dusky-brown, and their edges light fulvous-brown; coronal feathers lengthened, as in the Larks generally: beneath pale fulvescent, the throat white, and the breast marked with large oval blackish spots: primaries and secondaries ferruginous on both webs of each feather, except towards the tip, this dusky portion increasing to the outermost: tail blackish, its four middle feathers brown, and the outermost only white on its external web: bill and feet pale, the beak tolerably thick. Inhabits the more northern portion of the peninsula of India, being represented by the next species southward.

3. *M. affinis*, Jerdon, MS. Very similar to the last species, but having much less ferruginous colour on the wings, this being confined to the outer webs of the primaries, and a deep internal margin to the basal half only of their inner webs, never extending across the feather as in *M. erythroptera*, but continued throughout the length of the inner margin of the secondaries: the wing also is somewhat differently formed, being rounder, with the short first primary longer and broader, exceeding an inch in length, the second three-sixteenths to a quarter of an inch minus the third, which equals the next three in some specimens, whilst in others the fourth is somewhat the longest: and the tail-feathers are less black, with the external web of the outermost, and a slight exterior margin to the next, fulvescent-white, occasionally spreading more or less on the inner web of the outermost feather. Inhabits the southern part of the peninsula of India.

4. *M. Hayi*, Jerdon, MS. Also very like the two preceding species, but readily distinguished by its coronal feathers forming a pointed crest, and by the total absence of rufous on the outside of the wings, while on the inner surface this is pale and diminished in quantity: the under-

parts also are nearly uniform pale rufescent, but little whiter on the throat, and with but few and small dark spots on the breast; and the sides of the occiput above the ear-coverts, with the nape and sides of the neck, are pretty much of the same colour as the parts below. The wings, too, of this species are remarkable for having the first primary but half an inch long, while the second equals or even somewhat exceeds the three next: and the tail has its outermost feather wholly to near the base, and also the greater part of the next, rufous-white. Discovered on the eastern coast of the peninsula by Lord Arthur Hay, a zealous and successful cultivator of Ornithology, to whose honour the species has been dedicated.

5. *M. cantillans*, Jerdon, MS.; the true *Aggun* of the natives of India. Most allied to the last species, and having nearly the same form of wing, but at once distinguished by the absence of any marked crest, and by having the outer web only of the penultimate tail-feather white, together with the whole of the outermost excepting an oblique basal third of its inner web. Length five inches and three-quarters, by ten inches in alar expanse; wing two inches and seven-eighths (or two and five-eighths in the female); tail two inches: first primary three-quarters of an inch, the four next generally about equal, but the second and fifth sometimes a trifle shorter. Upper-parts dusky brown, the feathers laterally margined and slightly edged at tip with rufescent-brown, imparting a little the appearance of the nestling plumage characteristic of the Lark tribe: alars and their coverts margined with rufous-brown: a pale streak over the eye; throat and below the ear-coverts whitish; and the under-parts pale rufescent with small breast-spots, in general not very distinct. Bill dusky horn-colour, the lower mandible pale; and feet fleshy-brown. Inhabits Bengal as well as the Indian peninsula, and is a favorite cage bird with the natives for its sweet and plaintive, but not much varied, song.

6. *M. phenicura*, Franklin, P. Z. S. 1831, p. 119. Remarkable for the length and straightness of its wings, of which the first primary measures an inch, and the second is a quarter of an inch shorter than the third and fourth. Inhabits the peninsula of India.

*Coryphidea*, Nobis, n. g. In this form, the wings are long and straight, with the first three primaries equal (the representative of the usual small first one being obsolete). Bill rather short, subconical and moderately



compressed, but essentially Lark-like. Feet with shortish toes, and short but straight hind claw. The general contour much recalls to mind that of the northern Snowflecks (*Plectrophanes*).

*C. baghaira*; *Emberiza Bag-haira*, Franklin; *Baggeyra Lark*, Lath. *Alauda dukhunensis*, Sykes, *P. Z. S.* 1832, p. 93; described as *Corypha baghaira*, *J. A. S.* XI, 200: *Ortolan* of Europeans in India.

*Alauda*, Lin. Typical Larks.

1. *A. arvensis*, Lin. Nepal. Specimens of this bird sent as a new species by Mr. Hodgson differ in no respect from others killed in England.

2. *A. gulgula*, Franklin, *P. Z. S.* 1831, p. 119; described in *J. A. S.* XI, 201.—Var. (?), *A. gracilis*, Nobis, *J. A. S.* XI, 201; *A. gulgula*, apud Sykes and Jerdon.—Var. (?), *A. leiopus*, Hodgson, *MS.* A puzzling species, either subject to some degree of local variation, or, in Mr. Jerdon's opinion, separable into at least three most closely allied species as above indicated. Comparison, however, of numerous specimens from various parts renders the definition of these species or varieties extremely difficult, if not impossible. Those from southern India have the colours more intense, and for the most part agree with the Bengal specimen which I ventured to separate by the name *A. gracilis*, even according very commonly in the trivial distinction which I pointed out, of having the penultimate tail-feather somewhat largely tipped with the rufescent-white continued along its outer web, and this trifling character I have sought for in vain among heaps of the ordinary Bengal Lark killed for the table. Again, Mr. Hodgson marked a Nepalese specimen of the common Bengal variety as being probably distinct in species from his *A. leiopus*, and one of his specimens of *leiopus* resembles most minutely the common peninsular variety (or *A. gracilis*), while in general the Nepalese specimens seem to be rather short in the bill, and to have the outer tail-feathers of a purer and brighter white than in the others: but I confess my inability to draw up any marked and constant distinguishing characters. Specimens exactly resembling the common Bengal bird were procured by Sir A. Burnes in Scinde; and one from Arracan is remarkable for being rather small, and for having the exterior web of the penultimate tail-feather merely narrowly edged with rufous-white, instead of this occupying the whole outer web of the feather in question. I should remark that the Nepal specimens are also, in general, a good

deal less rufescent underneath than those from southern India, while the Bengal ones are in this respect intermediate. The common Bengal Lark very closely resembles the preceding species, or British Sky Lark, in its song and habits.

3. *A. malabarica*, Scopoli and Gmelin; *A. deva*, Sykes, *P. Z. S.* 1832, p. 92; Jerdon, in 'Madras Journal,' XI, 31. So closely allied to the preceding as to bear out the supposition of the distinctness of the different races of the latter which I have brought together; but at once distinguishable by the pointed form of its crest. Indian peninsula.

4. *A. raytal*, Buch. Hamilton, *MS.* Length five inches and a quarter, by eight and a half across; of wing three inches and three-eighths; tail two and one-eighth: bill to gape five-eighths; tarse three-quarters, and hind-toe and claw half an inch. General hue of the upper-parts brownish-ashy, with narrow dark centres to the feathers; of the lower white, faintly tinged with yellowish on the breast, where obscurely marked with small spots; wing-coverts and tertiaries margined with pale fulvescent; outermost tail-feather white, except the inner half of the internal web throughout its length, and the next tail-feather white along the marginal half of its outer web only; there is also a whitish line through the eyes: bill pale horny; and legs yellowish, the hind-claw not exceeding the toe in length. I obtained a fine specimen of this bird alive, and kept it for some time, when just as it had come into good plumage it died, and, as a specimen, was destroyed by the ants. Buchanan Hamilton received a pair from Lucknow; and an example of apparently the same species was procured by Sir A. Burnes in the west.

*Certhilauda*, Swainson. Larks with slender incurved bill, and small first primary-quill to the wing. With the following exception, so far as known, natives of Africa.

*C. chendoola*; *Alauda chendoola*, Franklin, *P. Z. S.* 1831, p. 119, (nec apud Jerdon). Bengal, Nepal, Northern India generally, extending westward to Scinde.\*

\* The following description was taken from a pale specimen of a large, thick-billed, subcrested Lark from Afghanistan. Length seven inches, or more; of wing four inches; and tail two and a quarter; bill to forehead three-quarters of an inch, thickish and compressed; tarse an inch or nearly so. Head crested as in *A. arborea*. Colour of *variety* pale sandy fulvescent-brown above, the centres of dorsal feathers darker, those of crown but slightly so: under-parts whitish, fulvescent on breast, with much

I have reason to believe that the series of *Alaudinæ* here given is yet incomplete; but that very few species, on the whole, remain to be added to the present synopsis of Indian *Fringillidæ*, notwithstanding that many more are currently ascribed to India in the old systematic works. With the assistance of the accompanying plate, little difficulty will be found in recognising the various divisions of these birds, which I have seen reason to adopt, if the descriptions themselves do not suffice for the purpose; and I may hope and expect that this endeavour at reducing the group to something like order, will lead to further examinations, more especially in the Himalaya and to the westward, in which latter direction we have at present by far the most to learn of the Zoology of India.

Of the birds noticed in this paper, the following species are all that are absolutely wanting to the Society's Museum:—*Passer pyrrhopterus*, *P. (?) concolor*, *Pyrrhuloides epaulatta*, *Carduelis caniceps* and *C. Burtoni*, *Emberiza flavicollis*, *E. sordida*, and *E. Buchanani*, and the male of *Pyrrhospiza punicea*, and female *Passer pyrrhonotus*: but better specimens are desirable of many more, as especially *Proparus chrysotis*, *Parus* (or *Sylviparus*) *modestus*, *P. dichrous*, *P. æmodius*, *P. melanolophos*, *P. iouschistos*, and *P. erythrocephalus*, *Passer pyrrhonotus*, *Amadina acuticauda*, *Estrelida formosa*, *Pyrrhula nipalensis* and *P. erythrocephalus*, *Chrysomitris spinoides*, *Emberiza Lathamii*, *E. icterica*, and *Alauda raytal*; and, in general, specimens of the Himalayan *Fringillidæ* are very acceptable, for transmission to the Honorable Company's and different European national Museums.

blackish on the sides of the fore-neck meeting across: tail, excepting its middle feathers, having a subterminal dusky band, and tipped with pale fulvescent: also a pale superciliary streak to sides of occiput; and the beak and legs pale.

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*Memoir on Indian Earthquakes. By Lieutenant R. Baird Smith, Bengal Engineers.*

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*Part III. Analysis of the Phenomena of Indian Earthquakes, as exhibited in the two preceding parts of this Memoir.*

All available facts connected with earthquakes in India and its frontier countries having now been given, it remains that the inferences authorised by these facts shall be duly exhibited. To this limited object I propose confining myself, it forming no part of my design to offer any general views of the theory of Earthquake shocks, but simply to illustrate their nature and causes so far as the materials collected in this country admit. The combination of these materials with others gleaned from different earthquake tracts, will doubtless lead to interesting general results, but such a work must be left to some one who commands better opportunities and greater leisure than I at present have.

The facts already given naturally subdivide themselves into two main classes; first, those illustrating the various phenomena; and second, those indicating the causes of earthquake shocks. To the former, attention will in the first instance be directed.

*1. Characteristics of the Shock in Earthquakes.*

The sensations experienced during earthquakes, as described by observers, are of three kinds.

*a.* A sensation of undulatory movements illustrated by comparison with the motion of a ship at sea, the wavelike progress of a snake in water, or the rocking of a cradle.

By far the larger portion of shocks in India give origin to sensations of this character. It would be tedious, and it is unnecessary to detail a large number of examples, but reference may be made to the great shock of the 19th February, 1842, as peculiarly illustrative of the point under notice. At Jellalabad it is said, "the earth swung to and fro like the rocking of a cradle," and at Peshawar, "the earth rocked like an infant's cradle, or like a ship at sea.

*b.* A sensation of sharp, severe concussion, as though the observer were struck heavily from beneath or behind; as examples of this se-



cond class, the shocks of the 9th February 1841, and 5th March 1842, may be referred to. In the former case the shock is described as having been "sharp and stunning, as if a blow had been struck under you;" and in the latter, the observer felt as though he had received a severe blow from behind, and been impelled forward.

c. A sensation of tremulousness, without any defined motion or concussion. This feeling ordinarily follows great shocks, when the crust of the earth seems to be gradually subsiding from intense disturbance to its former state of quiescence. The inhabitants of the valley of Cabool, distinguish this merely tremulous shock by a peculiar term calling it, "Zill-Zillie," in contradistinction to "Goozur," which appears to be the word used for the first class (*a*); numerous instances of class (*c*), occur in the register, among which may be mentioned the central Himalayan shocks of the 18th August and 23d September 1832, the lateral Himalayan shocks which followed the great earthquakes of August 1833, and February 1842, and the shocks in the delta of the Indus from the 18th to the 26th June, 1819.

d. The next characteristic of the shocks to be noticed, is the method, of propagation. There is evidence of two varieties of this, (1,) when the shock traverses a zone of the earth's surface, the breadth of which is very small as compared with the length; (2,) when the shock is propagated on all sides equally as from a central point; the difference between the two varieties arises in all probability from difference of physical structure in the localities affected by the shock. The cases illustrating the first, as for example, the shocks of February 1842, or August 1833, occurred in the vicinity of great mountain ranges where faults and disturbances of the strata are numerous. The shocks were propagated in directions parallel to the mountains, and the breadth of the tracts affected by them was but small. The most marked case of circular propagation occurred in the alluvial plains of the delta of the Ganges on the 11th of November, 1842, and there, from the greater continuity of the strata, less obstruction would occur to the dissemination of the shock in all directions from the central point.

That shocks, whether they affect zones or spaces which, though not strictly circular, may yet for the sake of avoiding periphrasis be called circles, *are* propagated from central points or lines of maximum intensity is a fact so clearly established that it is scarcely necessary to advert to

it.\* The diminution of intensity with increase of distance from a central point is a phenomenon to be observed in all the principal earthquakes recorded in these pages, and although our observations are yet too imperfect to admit of our ascertaining precisely the place of maximum intensity, it is indicated generally in a sufficiently distinct manner.

Thus the valley of Jellalabad was the seat of the maximum intensity of the earthquake of 19th February, 1842, Lady Sale mentioning that its course from east to west was distinctly indicated by clouds of dust. The valley of Nepaul was also evidently the place of maximum intensity of the shock of 26th August 1833. Doctor Campbell observing that, "the valley of Nepaul though not geographically the central point, is most assuredly the portion that has suffered the greatest violence of the calamity." To the east and west of the valleys just mentioned the force of the shock probably decreased.

e. Had the materials collected admitted of it, I would willingly have given some examples of the velocity of propagations of earthquake shocks in this country, but unfortunately notices of time are so very imperfect and contradictory, that no inference worthy of confidence can be drawn from even the best of them. I must therefore content myself with a mere allusion to the velocity as a characteristic of the shock still requiring elucidation.

I now pass on to the next series of phenomena, viz. (2), motion of the ground during shocks.

The motion of the ground during shocks is of three different kinds.

a. A horizontal or forward motion, illustrated by the shock of the 5th March, 1842, during which an observer in Saharunpore felt himself, and the chair on which he was seated, impelled forward as if by a force applied from behind him. Another example is given by the shock of 3d April, 1810, (Part II. p. 47), in which it is stated, "the girandoles and lamps were seen to swing, and even the mirrors, (such as were fastened at the upper extremity with a cord), were seen to vibrate towards the wall". It may be inferred from this statement that the room in which these articles were suspended was moved bodily forward, while they by their inertia were left behind, and apparently moved towards the wall. In the account of the same shock a further illustration of the forward movement is given in the case of a person in the Lower Orphan School at Howrah, whose couch was

moved forward nearly a foot from its original position, and subsequently thrown back again; these instances will serve to explain the first kind of motion.

The second is:

b. A vertical, or as many observers style it, an “up and down motion”, with no lateral movement. This variety was well marked during the minor shocks that followed the great earthquake of the 26th August, 1833. Dr. Campbell remarks, “many of them have been severe, and throughout the whole course of these visitations, there have been two distinct varieties observed in the character of the shocks; all those at the commencement were of the undulatory or swinging kind, the others wanted the swell, and were a violent up and down shaking, with little lateral motion.” The shocks of the 4th October and 29th November, 1833, which were severe, were of the vertical kind.

c. The third kind of motion observed is a combination of the two preceding, giving rise to an undulatory movement or swell like that of the sea. This is by far the most common species of motion accompanying earthquake shocks, and is sometimes exhibited on a very large scale, as during the Jellalabad earthquake of 1842, the Nepaul earthquake of 1833, the Scinde earthquake of 1819. The surface of water in ponds and rivers frequently exhibited the undulation, as during the Calcutta earthquakes of the 11th November, 1842, and the great shock of the 2nd April, 1762, when the water in tanks in Calcutta rose upwards of 6 feet, and formed large waves.

In some instances the shocks commence with the vertical and terminate in the horizontal motion; this remark is illustrated by the phenomena of the shock of the 11th November, 1842, as described in Part I. p. 30. Two or three slight vertical shakes or heaves of the earth occurred, followed by a strong horizontal movement; this peculiarity seems to have been observed in Calcutta only; at other places the movement is described as of the purely undulatory character.

The undulatory motion has been remarked as invariably the most destructive kind of shock. Thus Dr. Campbell remarks of the Nepaul shocks in 1833, that the swinging motion was alone destructive to property, while the vertical, from the greater noise and more rapid succession, was the more terrifying. This difference of the two kinds of motion is easily explicable; the vertical shock merely raises the

building up without altering its centre of gravity; while the waving motion throws it completely out of equilibrium and insures its fall; the horizontal motion is occasionally destructive, but not so much so by any means as the undulatory.

### *3. Miscellaneous effects on the Earth's crust.*

A certain degree and kind of motion of the ground accompany all earthquake shocks, but there are other effects on the earth's crust which are only occasionally observed; these may now be noticed.

*a.* Alterations of level. The most remarkable cases of permanent alteration of level caused by earthquakes recorded in this memoir, are the Arracan and Chittagong earthquakes of 1762, and the Scinde earthquake of 1819. In the former case there is evidence of an upheavement of a large extent of the eastern coast of the Bay of Bengal, while in the latter the Ullah Bund, was suddenly raised and most striking changes occurred in the level of the eastern branch of the Indus. Subsidences of extensive tracts of country accompanied these upheavements: referring to Part II. page 48 and 50, examples of this kind of action will be found in abundance, and in the account of the Scinde earthquake, the formation of a salt water lagoon or marsh of nearly 2,000 square miles in area is noticed. At one part of the eastern branch of the Indus, a depression of level to the extent of 17 feet is recorded, while in other parts it varied from 4 to 10 feet.

*b.* Rents in the ground with ejection of water and gases.

A remarkable example of rents in the ground accompanied by the ejection of fetid water occurs in the account of the Cashmere earthquake of June 1828. Mr. Vigue remarks, "the earth opened in several places about the city, and fetid water, rather warm, rose rapidly from the clefts and then subsided.

Another remarkable instance of a great rent occurs in the Calcutta earthquake of 1737, when the English church is said to have sunk bodily into the ground.

In the Matura earthquake of 1803, extensive fissures were observed in the fields, through which water rose with great violence, and continued flowing from the 1st to 24th of September.

During the Chittagong earthquake of 1762, many great fissures in the earth occurred, from which water in large quantities rushed with



“prodigious” violence; these waters were strongly impregnated with sulphureous gas.

c. Landslips. These are confined to mountainous regions, and in the central Himalayan tract have been exhibited on a large scale. The effect of the earthquake of 1803, as described by Colonel Hodgson, in producing such slips of enormous masses of rock were of the most destructive character. “Whole villages” he remarks, “having been buried by the fall of cliffs and sliding down of the faces of hills.” Another instance is recorded on the authority of Dr. Falconer, as having occurred in the same region in 1809, when the Bishnoo Gunga, one of the great branches of the Ganges, was blocked up by a landslip, and the water raised to 40 feet above its usual level. Colonel Hodgson notices the slip of a whole face of a mountain 4,000 feet high, during the earthquake of the 28th May 1817. During the Cashmere earthquake of 1828, large rocks and stones were seen to roll down from the mountains, and by the Nepaul shock of 1833, the Passes across the Himalayas from the valley towards Lassa, were completely blocked up by rocks and earth thrown down from the mountains. By the Chittagong earthquake of 1762, several hills are described as having been rent asunder, sinking down and stopping up the river near them; these examples sufficiently illustrate the extent to which landslips occur during earthquake shocks, and furnish striking indications of the great energy of the disturbing forces in operation.

d. Formation of sand cones. The only instance recorded in which these cones, so frequently observed during the Calabrian and South American earthquakes, were formed, is in the Scinde and Cutch earthquakes of 1819. “During the earthquake,” it is remarked (Part II. p. 33,) “numerous jets of black muddy water were thrown out from fissures throughout this region (the Runn of Cutch,) and cones of sand, six and eight feet high were thrown up;” no facts are given whereby we can form any opinion as to the method in which these cones are formed, or of the causes to which they are due.\*

e. Effects on springs. The Jellalabad earthquake of the 19th February, 1842, furnishes the only ascertained instance of a shock having produced any perceptible effects on springs. These effects

\* We are informed that in the valley of the Irrawaddy no earthquake occurs without numerous ejections of *black sand*, stinking water, &c. &c. This locality is subject to very frequent shocks.—Eds.

are described in Part. I. of this Memoir; the water of the Sonah spring was deprived of its ordinarily high temperature, and the quantity of water discharged fell much below the usual average, and the flow occasionally ceased altogether.

I have no doubt that were observations to be more minutely made, many cases of this class would be discovered; they are not unusual in other earthquake tracts, and doubtless frequently occur in India.

#### *4 Sounds accompanying Shocks.*

*a. Subterranean sounds.* Although sounds as if in the interior of the earth are occasionally noted as accompanying shocks, they would appear to be rare. An example is found in the first shock of the Great Nepaul earthquake of 1833. During this shock there was a distinctly audible noise as of ordnance passing rapidly over a draw-bridge, of which Dr. Campbell remarks; "I felt it was travelling with the speed of lightning towards the west, and just under my feet;" a second case occurred at Ram Sing Chok, north-east of the Nepaul valley, where it is said that for four or five days preceding the earthquake, "noises similar to the firing of cannon were heard as if under ground;" a third example is furnished by the Jellalabad earthquake of February 1842, of which Lieutenant Eyre remarks, "A loud subterraneous rumbling was heard as of a boiling sea of liquid lava, and wave after wave seemed to lift the ground on which we stood, causing every building to rock to and fro like a floating vessel." These are the only cases I have found in which sounds appeared to be in the earth.

*b. Sounds in the air.* These sounds are of two different kinds; 1st explosions, which vary in intensity from the sound of a cannon to a rumbling noise; the Cashmere earthquake of the 26th of June 1828, furnishes an example of the highest degree of intensity; "on that night," Mr. Vigne states, "only one shock took place, but just before sunrise there was another accompanied by a terrific and lengthened explosion louder than a cannon; on that day there were twenty such shocks each with a similar explosion;" similarly in describing the Nepaul shock of 1833, Dr. Campbell remarks, "in a dead calm the noise of a hundred cannon broke forth." The Jellalabad earthquake of 1842, was preceded by a "rumbling noise like a heavy wagon rolling over a wooden bridge." Under dates 25th July, 26th September, and 6th November

1842, other examples of the rumbling noise accompanying shocks will be found.

2d. A rushing sound. In describing the shock of 2d July 1832, (Part II.) Dr. McClelland remarks, "during twelve seconds the earth shook or rather trembled, and afforded a noise which it is difficult to describe, but which may be compared to the sound of a heavy but transient rush of water: the noise preceded and succeeded the motion about three seconds." Similar rushing sounds accompanied the shocks of the 23d September 1832, 30th May 1833, and 4th January 1835. The Calcutta shock of the 11th November 1842, is described as having been accompanied by "a noise which at first resembled a mighty rushing wind," and afterwards "the loud rattling of carriages over a stony street;" the shock of the 19th June 1819, as felt at Chunar, "was accompanied by a noise in the atmosphere resembling the rapid flight of birds."

These sounds always appear to be in the air, and although not invariable accompaniments of earthquake shocks, are rarely wanting. The movements of the crust of the earth must communicate similar movement to the air, and hence give rise to sounds; but it must be confessed that this cause is not sufficient to explain satisfactorily the loud and sudden explosions, and the peculiar rushing or whizzing sounds, that are so often observed; explanatory evidence is not yet collected to enable us to form a confident opinion, and although plausible speculative causes might be stated, I prefer waiting for further information, especially as among materials not yet arranged, there appear some facts which may illustrate this subject.

There is a notice of a sound observed during the Scinde earthquake of 1819, which although merely incidental and far from specific, yet merits remark. Under date the 25th June 1819, (Part II. p. 36,) an observer at Porebunder states, "the late phenomena have brought to my recollection, my having observed to an Officer of the Marines about the beginning of March last, that there was a cloud in the north east, which appeared uncommonly charged with electric matter; its direction was nearly opposite to the one from which I heard the sound that preceded the great shock of the 16th." It is perhaps rash to base any inference on an isolated fact like this, but it leads me to suspect

that the peculiar rushing or whizzing sound previously alluded to, is an indication of the discharge of electric matter, such a sound being familiar to those who have ever watched the phenomena of electric discharges in the laboratory.

*5. Meteorological Phenomena accompanying shocks.*

*a.* Barometric observations on the state of the Barometer during earthquakes in India, are few in number and not decisive in their results. In relating his account of the shock of the 23d January, 1832, Lieutenant Burnes notes, "the atmosphere had indicated nothing unusual before the earthquake, nor did the Barometer undergo any variation before or after it." During the Calcutta earthquake of the 11th November, 1842, an interesting Barometric phenomena was observed in St. Xavier's College, where the mercury rose and fell repeatedly to the extent of seven or eight tenths of an inch during the shock; "again, during the same shock, an observer on board the ship "Southampton" in describing a peculiar luminous appearance that accompanied the earthquake remarks, "the Barometer had slightly fallen previous to this, whether from the preceding rain or caused by the earthquake it is for others more capable to judge; I am inclined to think from the latter." It is difficult indeed to say whether the movement in this case was merely a result of the earth's movements, or of atmospheric disturbance, but from the quantity of rain that accompanied the shock, it is probable it was due to the latter. The following notices however throw considerable doubts on the Barometric movement in this case, and shew that it certainly was not general; Mr. Piddington remarks, "it did not occur to me to examine the Barometer, but I found no difference afterwards at home, and a friend who has an excellent Simpiesometer assured me that no effect was produced upon it, he having examined it immediately afterwards, so that in slight shocks the atmosphere seems to have no share."

Arranging the materials given in the general Tabular view of Indian earthquakes, (part II, p. 63,) so as to exhibit the relation of the number of shocks to the months of the year, we have the following general results:—

Number of shocks in January, .. .. .	7
„ „ February, .. .. .	7
„ „ March, .. .. .	3
„ „ April, .. .. .	15
„ „ May, .. .. .	46
„ „ June, .. .. .	14
„ „ July, .. .. .	4
„ „ August, .. .. .	15
„ „ September, .. .. .	14
„ „ October, .. .. .	8
„ „ November, .. .. .	4
„ „ December, .. .. .	5
Total, .. .. .	144

Dividing the year into two portions, from May to October, the summer and rainy seasons; and from November to April, the winter and spring seasons, we have the following distribution of shocks throughout the year.

During summer and rainy seasons, .. .. . 93 Shocks.

„ cold „ spring „ .. .. . 42 „

Excess in summer and rainy „ .. .. . 51

Had all the minor shocks been taken into account, the excess would have been very much greater, but the above is sufficient to shew that earthquakes are much more frequent in the months between May and October, than during the remainder of the year. Of these months, June, July, and August exhibit some of the severest shocks, as also the greatest number.

Now from May to October, the mean height of the Barometer is invariably less than from November to April inclusive. Prinsep's Meteorological Tables, (As. Soc. Journal, vol. I. p. 29,) furnish materials for comparison on this point, for several places within the earthquake tracts adverted to in the preceding part of this Memoir. The following three are given as illustrations.



*Calcutta.*

Mean height of Barometer from May to October,	..	.	29.606
Ditto, ditto, November to April,	..	..	20.908
			<hr/>
			.. 302
			<hr/>

*Ava.*

Mean height of Barometer from May to October,	..	..	29.461
Ditto, ditto, November to April,	..	..	29.684
			<hr/>
			...283
			<hr/>

*Saharunpore.*

Mean height of Barometer from May to October,	..	..	28.573
Ditto, ditto, November to April,	..	..	28.959
			<hr/>
			...386
			<hr/>

It therefore appears that during the six months of the year when the Barometer is lowest, the greatest number of earthquake shocks occur, and further, since during the months of June, July and August, the mean of the height of the Barometric column is lower than at any other period of the year, (taking averages of a number of years), there appears an interesting coincidence between the greatest intensity of the forces to which earthquakes are due, which are displayed during these months, and the minimum weight of the atmospheric column. I note this point as an interesting one, since it has been observed in other earthquake countries, and it appears to be one of those facts which will be found intimately connected with the theory of earthquakes.

There are other facts, to be noticed immediately, which further establish the connection between the depressed state of the Barometer and the occurrence of earthquake shocks, such as heavy rains, hurricanes and storms, a close and sultry state of the air, &c. These will be recorded in their proper order and are now merely alluded to as tending to establish the connection just stated.

*b.* Direct Thermometric observations on the Thermometer during our Indian earthquakes are as rare as those on the Barometer, but the uniform testimony of observers establishes the fact, that a high

temperature is an almost invariable accompaniment of such shocks. Parts I and II, present many examples; but a few of the principal only need be stated in illustration of the point under notice. During the great shock of June, 1819, it is stated that "the heat for the last two or three days has been excessive." Relative to the weather preceding the Jellalabad shock of the 19th February 1842, Captain Eyre remarks, "On the 6th we had a heavy fall of rain since which the weather has become exceedingly close, this morning (the 19th), it was observed that an unusual degree of heat and stillness pervaded the air." An interesting notice occurs regarding another Jellalabad shock under date the 21st July 1842, it is as follows: "a severe shock of an earthquake was experienced at Jellalabad on the 21st at a little past 9 p. m., a reduction of temperature followed it." The Calcutta earthquake of the 11th November 1842, was also preceded by very hot weather, as were those of the 21st and 23d May of the same year. A specific statement of the condition of the Thermometer at Calcutta during the great Chittagong earthquake of April 1762, is given by the Rev. Mr. Hirst who remarks, "the heights of the Thermometer on Farenheit's scale was then at Calcutta, 95.30," much higher than it had been observed to be during the whole month. The preceding will suffice to shew that great heat is a characteristic of the weather accompanying earthquakes in this country, the high temperature seems to precede the shock, a decrease to follow it.

It has formerly been remarked that the largest portion of shocks occur, during the months between May and October, or the hot and rainy seasons of our year. May, usually the hottest month of the year, shews the largest number of shocks, a number indeed as may be seen on referring to the table of distribution of shocks throughout the year, very much greater than any of the rest. The inference from particular cases of earthquakes is therefore confirmed by the result of the general examination of the whole number recorded.

c. *Pluviometric.* Heavy rain although certainly not an invariable, is a very frequent accompaniment of earthquakes in India; the rain in some instances follows, in others precedes the shocks. The Nepaul earthquake of August 1833, is an instance of the former, it being noted, "that torrents of rain fell in the valley, washing down the walls that had formerly only been shaken." Relative to the

earthquakes of the Jellalabad valley, as illustrations of the latter, Captain Eyre remarks; "These shocks have always appeared to me to be in some way connected with heavy rain beforehand." Similarly during the shock of the 11th November 1842, heavy rain fell during the shock, none having fallen for some time before. The shock having been felt about half past nine P. M. the rain commenced about 8 P. M. and continued till about 2 A. M. Captain Hannay records in his notice of the earthquake of the 14th January 1839, experienced in Assam that "some days of heavy rain in the valley, and snow in the mountains preceded it," also in his notice of the shock of the 3d June 1839, it is observed the weather was wet and disagreeable. It would therefore appear that heavy rain before, during and after shocks has frequently been observed; and this remark, founded on our local experience, is interesting, as being in perfect analogy with observations made on earthquakes in other parts of the world.

*d. Winds and storms.* There are several cases noted in the preceding parts in which a connection is indicated between earthquake shocks and atmospheric currents. The circumstances accompanying them are such as to render it difficult to suppose that the connection was merely an accidental one. Thus during the Calcutta shock of the 11th November 1842, it was observed, that "there was an unpleasant stillness in the air previous to this occurrence (the earthquake), but the wind rose strongly from the eastward almost immediately afterwards." Again in the notice of the Delhi earthquake of the 24th October 1842, it is remarked, "the wind was west, from which quarter it had been blowing steadily for some days, but just previous to the earthquake it was in strong gusts." The great Calcutta shock of October 1737, was accompanied by "a furious hurricane at the mouth of the Ganges which reached 60 leagues up the river," and the shock of April 1810, in the same locality, occurred contemporaneously with a heavy north-wester. The Chittagong earthquake of 1762, was in like manner accompanied by "fresh gales of wind at south-east" and lastly, the severe shock of the 19th October 1800, at Ongole, occurred while "the wind was blowing a hurricane, and rain so heavy was falling that the whole country exhibited an entire sheet of water." These cases may suffice to draw attention to the possible connection of earthquakes with variations of winds

and the occurrence of storms. That the connection is not an invariable one, scarcely lessens the interest of the enquiry, as observations may yet be accumulated which will exhibit the causes of this variability, and throw light on the true nature of the dependence of the earthquake and atmospheric forces on each other. As a very interesting indication of this dependence, arrived at by a totally different course of enquiry from the present, I may quote the few following remarks from Mr. Piddington's Sixth memoir on the Law of Storms in India (*Journal Asiatic Society*, No. 127, p. 717.) "Before I conclude, I must allude, as a question of research only, to another remarkable feature in these tracks, and indeed all the storm tracks we have yet traced out, which is this: If we look at the chart, we shall see that almost the whole of the storms seem to come in groups from certain quarters, and these quarters are those in which active and half extinct volcanoes are situated.

"Considering our charts in this point of view, we shall observe that, to commence from the northward six tracks, Nos. XXIX to X appear to come from the north-eastward, or from the direction of the great volcanic centre of the Japanese archipelago. Between these we have two tracks, Nos. II and XIX, which may be supposed, if they originated at so great a distance, to have come from the active volcanoes at the north extremity of the Marianas, as may also Nos. XVIII and X.

"We have then two groups from Nos. VIII to XXVII, which all pass over, if they do not arise from active or half extinct volcanoes; the north extremity of Luzon having the volcano of Camiguin, and another yet active, while a chain of active or half extinct ones extends through the almost unknown centre of that Island.

"We have next a group of three storms, Nos. XVI to XXI, which appear to issue from the straits of Mindoro, the eastern extremity of which has the great volcano of Albay; and to the south of it, the half extinct or active ones of Samar, Leyte, and Mindanao. Lastly we have a group of three tracks which originate at or cross the Island of Palawan, which having itself active volcanoes, has also to the south eastward of it Mindanao, with Siao, and Sangir a chain of active volcanoes." Mr. Piddington after stating that his object is simply to draw attention to circumstances sufficiently remarkable to merit it, further remarks, "I have already alluded to the well known fact at Manila



that no hurricane occurs without some volcanic action more or less violent being observed, and as the whole of the chain of the Phillipines from Mindanao to the northern extreme is full of active or partially active centres, far more so even than Java, there seems good ground for supposing some connection, but whether the volcanoes are the cause, or are agitated by the effect of the atmospheric disturbance, we are as yet ignorant. In the Bay of Bengal, if the tracks of most of our storms be prolonged to the south-east they will all be seen to start from near the yet active volcanic centre of Barren Island, and some of the old ones which I have traced certainly do the same.

“Again; if we look at Mr. Redfield’s chart of West Indian hurricanes, we shall find them also mostly beginning about the volcanic Leeward Islands. The neighbourhood of Bourbon and Mauritius, and the Timor sea, where hurricanes seem very prevalent, are all instances of this sort of relation whatever it may be, if it really exists.”

The general question of the relation of volcanic to atmospheric disturbances is one well worthy of investigation, and it is to be hoped that observers favourably situated may not neglect opportunities of collecting such information as may throw light upon its true character. Circumstances are favourable for observations on this point in the earthquake tract of the eastern coast of the Bay of Bengal, including Chittagong, Arracan, &c. along the whole of the Malayan Archipelago and the coast of the Persian Gulf.

*e. Mists and Fogs.* The last indication of atmospheric disturbance during earthquakes I have to notice, is the not unfrequent occurrence of mists and fogs in connection with the shocks. Thus during the earthquake of the 21st May 1842, it is noted “that for some days before and after this, the sky had a white, thick, hazy appearance;” again during the Assam shock of the 4th March 1840, it was observed by Captain Hannay, that although “the sky was cloudless yet the atmosphere was hazy.” The shock of the 24th October, 1832 near Delhi was in like manner accompanied by haziness in the air.

The general results under this head may now be summed up in a few words. The atmospheric phenomena which have been observed to accompany earthquakes in India, so generally as to suggest the existence of an intimate connection between the two classes of facts, are, a depressed state of the Barometer, unusually high tem-

perature, frequently very heavy rain, accompanied by storms and changes of wind with occasionally a misty and foggy state of the atmosphere.

#### *6. Electric Phenomena accompanying shocks.*

These have been observed but rarely in this country, a few instances however are recorded. During the earthquake of the 7th September 1842, at the moment of its occurrence, sensations precisely similar to those accompanying an electric shock, were experienced by an observer at Mussoorie in the Himalayas, as noted in detail in the register for 1842. During the shock of the 11th of November, of the same year, a peculiar brightness was observed on the waters of the Hoogly which was exactly contemporaneous with the shock, and on closing round the Southampton communicated to that vessel "a general and severe tremor as if a taut cable was grinding under the keel, or that a sudden squall had struck the ship." It was observed that this brightness could not possibly be the reflected light of the moon and the possibility suggests itself that it may have been a display of electric light. An interesting fact is noted among the Porebunder observations on the great Scinde earthquake of June 1819, under date the 24th of that month; after a severe shock accompanied by much rain, it is noted "Immediately after it observed a long narrow black cloud, running west and east, or quite the contrary way to what I am accustomed to see a line of such cloud extend: it appeared stationary for half an hour, during which time there were constant tremors in the earth." It is possible that these tremors may have been an effect of what has been called "the return stroke" or the passage of electric matter from the surcharged earth to the clouds, a not unusual phenomenon. During the month of April 1762, when the great Chittagong earthquake occurred, it is remarked by the Reverend Mr. Hirst, that "there was much thunder and lightning in this month." Similarly during the shock of the 29th October 1800, the incessant thunder and vivid lightning are specially remarked; it would therefore appear that severe shocks of earthquakes are frequently accompanied by electric phenomena, and although the facts may not be sufficiently determinate to enable us to say that such

phenomena are essentially connected with earthquakes they are yet enough to warrant our drawing attention to the subject and endeavouring to secure information more minute and specific.

We have not as yet any evidence from this country to indicate a connection between earthquake shocks and disturbances of the magnetism of the earth, although both in Europe and in South America, such a connection has been very distinctly exhibited, so much so, as to lead some to propose the magnetic needle as the best indication of earthquaking forces. The magnetic observatory of Singapore situated in the midst of one of the greatest tracks of volcanic force in the world, is peculiarly favourably placed for observations on this point, and as several earthquakes have occurred since its establishment it may be hoped that some interesting information has been collected.

#### *7. Volcanic Phenomena accompanying shocks.*

A few instances occur in the preceding portions of this memoir in which earthquake shocks are intimately connected with the action of volcanoes. Thus regarding the Scinde earthquake of 1819, it is remarked "the first and greatest shock occurred at a few minutes before 7 P. M. on the 16th June, but shocks of inferior violence continued till the 20th, when the volcano called Denodur, situated 30 miles north west from Bhooj the Capital of Cutch, burst into action and the movements of the earth immediately stopped." Again during the great shock of April 1762, it is observed by Mr. Edward Gulston "as we are informed that two volcanoes opened, I am in great hopes these will prove a sufficient vent to discharge all the remaining sulphureous matter in the bowels of these countries and put a stop to any further earthquakes here, at least for many years to come." During the principal shock of the Nepaul earthquake of 1833, vapour and flame were seen to issue from Nayadong one of the largest of the mud volcanoes of the Arracan coast. Whether these resulted from the mechanical effect of the concussion in opening some new fissure in the volcano or from an actual subterranean connection between the disturbing forces of the lateral Himalayan and Arracan tracts, there is no evidence to determine; the cases just noted occurred in volcanoes situated very near to, or actually upon the sea shore, a point which in the theory of the subject is worthy of

note, although, in accordance with the plan laid down for this analysis, I do not dwell upon it here.\*

### 8. *Physiological Phenomena accompanying Earthquake shocks.*

Without inferring any actual connection between earthquakes and the diseases which are not unfrequently found to accompany them, the coincidence between the two is sufficiently remarkable to merit a brief notice in this analysis. The first instance is recorded in the note from Mr. Wathen's memoir on Kokan, (Part 2, p. 3,) where it is mentioned that in 1832 and 1833, the province was visited by constant earthquakes and simultaneously devastated by cholera. Again in 1828, during the severe earthquakes of that year in Cashmere, the cholera made its appearance with very fatal consequence to the inhabitants of the valley. The following extract from the Agra Ukbar of the 19th November 1836, gives another interesting instance of the coincidence now under remark; "Sumbhul (Rohilcund) a series of earthquake shocks has been for some time and is still felt at this place, the shocks are of almost daily occurrence and are accompanied with a heavy rumbling noise which traverses the entire place; the duration of each averages two minutes; co-existent with the phenomenon is a fever of a more virulent nature than for years has visited the town."

The unpleasant personal sensations experienced during shocks are repeatedly alluded to in the previous pages. Considerable details will be found in Part II; indeed scarcely a shock is recorded in which these feelings of nausea, tendency to faint, pains in the limbs and general lassitude of the system are not adverted to; they resemble strikingly the sensations experienced by many when the atmosphere is overcharged with electric matter, and may serve as another indication that, during shocks excess of electricity actually exists. When it is borne in mind that during earthquakes, large quantities of sulphureted hydrogen and other deleterious gases are evolved, and that to the presence of the former of these, high authorities have attributed the fatal fevers of Africa, there is nothing irrational in supposing that continuous earthquakes may induce diseases of severe types. Without

\* In the account of the blowing up of the mountain of Gammacanore in the Moluccas in 1673, it is said that "there was first a great earthquake which overturned the surrounding villages and several thousands of persons were buried under heaps of stones. When the mountain blew up the weather was calm and very fine."—EDS.



attaching undue importance to the cases brought forward I may yet remark that the point is one well worthy of attention and investigation by better qualified parties.

### 9. *Concluding Remarks.*

Having now grouped as well as circumstances will allow, the various phenomena of Indian earthquakes, there remain only a few general remarks to conclude this part of the subject.

*a.* It will doubtless have been remarked that the localities subject to earthquake shocks, are characterised by certain features of general resemblance. In most, indications of volcanic action, of violent disturbing forces producing rents and fissures in the crust of the earth, of connection between the surface and interior of the earth, have been found. These features coincide with those of localities similarly affected in other parts of the world, and maintain that general analogy between earthquake tracts which has more than once been adverted to.

*b.* Of the earthquake tracts of India some are situated close to the ocean, others are removed from all connection, at least all external connection with it: this point is noticed because it has been thought by some that the presence of sea water is essential to the generation of the disturbing forces to which earthquakes are due. The central and lateral Himalayan tracts can scarcely have any connection with the ocean, removed as they are so far from it, and yet in these tracts, earthquakes of the utmost severity have been experienced.

*c.* The last peculiarity to be noted is the local nature of Indian earthquake tracts. Shocks occur in each of these with entire independence of the others, shewing that the forces operating in each are of local and limited extent. This circumstance is irreconcilable with the idea that earthquakes are due to the movement of a general fluid nucleus in the interior of the earth, it rather indicates that at various depths from the surface, reservoirs of materials, whether gases, fluids, or both, capable of generating disturbing forces exist, and that these reservoirs under ordinary circumstances act independently of all others.

To present at one view the contents of this part, the following tabular statement has been prepared.

*Synopsis of the Phenomena of Indian earthquakes.**1. Characteristics of the shocks.*

- a.* Undulatory shock.
- b.* Shock by concussion.
- c.* Tremulous shock.
- d.* Method of propagation.
- e.* Velocity of propagation.

*2. Nature of the movement of the Ground during shocks.*

- a.* Horizontal or forward movement.
- b.* Vertical or "up and down" movement.
- c.* Composite or wave-like movement.

*3. Effect on the crust of the earth.*

- a.* Alterations of level.
- b.* Formation of fissures with ejection of water and gases.
- c.* Landslips.
- d.* Formation of sand cones.
- e.* Effects on springs.

*4. Sounds accompanying shocks.*

- a.* Subterranean sounds.
- b.* Sounds in the air.

*5. Meteorological Phenomena.*

- a.* Barometric.
- b.* Thermometric.
- c.* Pluviometric.
- d.* Winds and storms.

*6. Electric phenomena.**7. Volcanic phenomena.**8. Physiological phenomena.**9. Concluding remarks.*

- a.* Geological resemblance of earthquake tracts.
- b.* Relation of earthquake tracts to the ocean.
- c.* Independent action of forces in Indian earthquake localities.

NOTE.—I may mention here that the large quantity of new materials connected with Indian earthquakes, which has come into my possession, since this paper was concluded will probably require the whole to be re-written so as to embody the new information obtained.

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*Notes, chiefly Geological, across the Peninsula from Masulipatam to Goa, comprising remarks on the origin of the Regur\* and Laterite ; occurrence of Manganese veins in the latter, and on certain traces of aqueous denudation on the surface of Southern India. By Capt. NEWBOLD, F. R. S. Assistant Commissioner, Kurnool.*

Masulipatam stands on the sea coast in nearly 16° N. Lat: and about 28 miles N. from the principal northerly embouchure of the Kistnah.

The adjacent country is the flattish maritime plain which according to Benza, extends between the mouths of the Godavery and the Kistnah.

The alluvial sands that cover the surface rest on a bluish black tertiary, or post-pliocene clay, resembling regur, imbedding terrestrial marine shells of existing species, and apparently identical with the black clay beds underlying the Cities of Madras and Pondicherry and other places on the Coromandel Coast. In many places the overlying sand is aggregated into a loose sandstone of a nodular form, and often perforated with sinuous and straight cavities, the work of *pholades*. The structure of this sandstone, which contains fragments of recent shells, is here concretionary. The cementing matter is clay, and carbonate of lime with a little oxide of iron. The sand continues to cover the plain to the distance of 15 or 16 miles inland, partially under laid by these beds of black clay, to within some miles of Bezwarah, when the gneiss is first seen to outcrop from these recent strata.

The plain of Masulipatam, it is quite clear, once formed the bottom of a lagoon, or marine lake, and was elevated and dried up probably in the post-pliocene period. The channel of the Kistnah, which it is likely supplied much of the fresh water, appears to have suffered a southerly deflection from the elevatory forces and consequent alteration of surface.

At Bezwarah the gneiss rises into a ridge, 600 feet high, running N. E. and S. W. its dip confused and contorted. Through a gorge in this ridge at right angles with its direction, runs the Kistnah. No evidence could be discovered of the Kistnah's having cut the channel through the ridge: it appears to have been originally formed, like the trans-

\* *Regur*, the black, tenacious, but usually fertile soils of central and Southern India are known by this name.—Eds.

verse river courses through the chalk escarpments of the weald, by the elevatory forces that raised the strata to their present position. The features of the original fissure have doubtless been modified by the abrading power of the river; which, when swelled by the freshes entirely fills the gap, about a mile in width, its sides rising rather precipitously from the river's banks.

Beyond this ridge, which is of no great length, the surface of the country appears flat as before, and the rise from the coasts scarcely perceptible. With regard to the theory, of the tract between Bezwarah and Condapilly having once formed the bed of an extensive lake, my friend Mr. Malcolmson has justly observed, that, "a careful survey of the hills from the summit shows, that they are short insulated ranges, such as are found over the Circars and other tracts rising from a level country; and that had a lake existed in the plain above, every slight rise of the river would have carried its waters round their shoulders to the North and South."

The gneiss composing the ridge of Bezwarah is garnetiferous, Cleavelandite often replaces the common felspar, and renders the gneiss liable to decay. It contains large veins of quartz, and is intersected by greenstone dykes, the presence of which may serve to account for the distortion observable in its strata.

A little to the N. E. of Bezwarah are the diamond mines of Mallavelly where the gneiss is in some places covered by a conglomerate sandstone, resembling the diamond conglomerate of Banganpilly and Kurnool, and of which it appears here as an outlying patch. The diamonds are however dug for in a bed of gravel composed chiefly of rolled pebbles of quartz, sandstone, chert, ferruginous jasper, conglomerate sandstone and kunkur, lying under a stratum of dark mould about a foot thick. Dr. Benza traced the conglomerate sandstone hence by Ellore and Rajahmundry to Samulcotah.

From Bezwarah by Condapilly to the vicinity of the Warapilly ghaut, the hypogene schists, chiefly gneiss and granite occur. East of Warapilly these rocks are covered by the Northern termination of the Cuddapah limestone beds. The diamond sandstone associated with this limestone, stretches still further North as already mentioned, by the diamond pit of Mallavelly to Samulcotah.

A little North of Warapilly, granite and the hypogene rocks con-



tinue to Hyderabad, and 48 miles to the N. W. of that city to the village of Moonopilly, on the Beder, where they are covered by the great overlying trap formation.

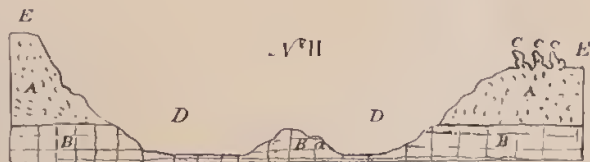
Most of the rocks about Hyderabad are of granite, that of Moeb Ally is of the laminar variety, often approximating to gneiss. The rock on which stands the celebrated fortress of Golconda, rises in the centre of the Valley of the Moossi, about 6 or 7 miles westerly from Hyderabad, and is composed of a granite with reddish felspar, translucent quartz, with dull dark green mica, and a few crystals of hornblende. Of this granite, which resembles that of Syene, the domes and outer walls of the Mausolea of the old Golconda kings are built. Through this royal cemetery runs a dyke of a dark crystalline greenstone, nearly E. and W., which is probably identical, from its direction, with a dyke observed 6 miles west of this, between the British residency and the great tank of Hussain Saugur. The rocks of the dyke bear evident marks of the chisel; and no doubt furnished material for the sepulchres of the Golconda kings, which are constructed of this, or an exactly similar greenstone exquisitely polished.

From Golconda the road towards Beder lies, for the few first miles, over the low granitic ridges which form the northern side of the Valley of the Moossi, to Lingumpilly, near which the ridge gently sinks into an undulating plain. Between this village, and that of Puttuncherloo, which is situate about 18 miles W. by N. from Hyderabad, the face of the country has a gentle N. W. declination towards the bed of the Mangera. Granitic rocks constitute its basis as far as Cummumpilly about 50 miles W. N. W. from Hyderabad. The granite is both of the small grained, red feldspathic variety, and large grained. Both varieties are met with at Kundi, and Moonopilly 48 miles from Hyderabad. The small grained is seen to penetrate the other in sinuous veins. There is also a third variety, fine grained, containing much quartz and imbedded nests of a dark steel coloured mica. Veins of reddish felspar with actynolite, and a little quartz also are seen. Both granite and gneiss, and the veins by which they are intersected, are penetrated by dykes of basaltic greenstone; the largest dykes observed were east of Puttuncherloo; a little W. of Lingumpilly and Mootinghi:—also at Sedashipett, and Yernanpilly. The Mootinghi dyke runs nearly N. and S., the rest preserve an Easterly and Westerly

N<sup>o</sup> I



N<sup>o</sup> II



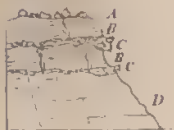
N<sup>o</sup> III



N<sup>o</sup> IV



N<sup>o</sup> V





direction. The felspar of the granite and gneiss near the line of contact, is deprived of its lustre and translucency: and becomes opaque and white like porcelain: the mica either almost disappears, or shrinks and becomes hard, compact, and of a ferruginous aspect; while the rock *en masse* acquires a tendency to split into rhomboids. Near the line of contact with the overlying trap a reddish felspathic zone is observed similar to that described as occurring on the trap and granite boundaries at Gurdinny in the S. Mahratta country, S. of Bejapore, which passes into pegmatite soil. The soil from Hydrabad and Golconda to Puttuncherloo is generally the light reddish sandy detritus washed down from the granite heights in the vicinity, occasionally mingled with nodules of a ferruginous clay resembling the debris of laterite. A little to the N. and W. of Puttuncherloo, the granitic soil thins out and disappears, leaving exposed the sheet of *Regur* that underlies it, and which occurs first at intervals, but afterwards as an almost continuous sheet from Moonopilly to Beder.

Between Puttuncherloo and Moonopilly the strips of granite alluvium with which it is alternated appear to have resulted from the decay of *salbendes* and bosses of granite, which formerly outcropped from the bed of the *Regur*, but have since crumbled down by a process of weathering, which I have described elsewhere; and being washed by the rains, have covered the surrounding soil with a *sandy* detritus thus:—(See plate, Diagram No. I)

A. undecomposed granite.

B. B. B. decomposed granite forming an alluvial surface soil.

C. C. *Regur*.

Near Sedashipett, a stratum of kunkur intervenes between the *Regur* and the granite. The surface of the *Regur*, where it overlies the trap from Moonopilly to Beder, is often intermixed with the detritus of the outcropping trap and laterite rocks associated. The soil resulting from the disintegration of the former is easily distinguishable from the *Regur* by its much lighter and reddish tinge, arising from the peroxidation of the protoxide of iron it contains. The *detritus* of the darkest portions of the trap, even before peroxidation takes place, have a greyish or greenish-brown hue, totally dissimilar to the *Regur*.

*Boundary of the great overlying trap formation of the Deccan.*—A little to the W. of Moonapilly, rounded and angular fragments of the



trap of the overlying formation, are seen lying on and partially imbedded in the *Regur*, with scattered, rugged, scabrous blocks of a compact cream and buff-coloured limestone passing into chert. The latter contained a cast of a small fresh water shell resembling a *Physa*.

Ascending the gentle slope, beyond the village of Cummumpilly, the overlying trap was first seen in situ in a section afforded by the steep bank of a nullah. The trap is petrographically identical with that of Bejapore. The structure is at once sheeted like that of modern lavas imperfectly columnar, and globular. The globular trap disintegrates by a process of concentric exfoliation. The concentric coats, weather into a brown speckled, friable wacke, which falling off and washed away by the rain leaves the hard spheroidal nuclei of basalt scattered on the surface; frequently in such numbers as to present the appearance of having being showered down by some volcano. These spheroids, vary in size from a pigeon's egg to a 16 inch shell.

*Recent conglomerate.*—A few miles to the S. of Sedashipett, a low flat topped range of hills is seen; which, from the calcedonies, jasper and fragments of trap brought down by the nullah, are probably of trap. These transported pebbles have been formed into a solid bed cemented together by lime, and form cliffs from three to ten feet in thickness on the nullah bank. Small rounded fragments of laterite are also included in this recent conglomerate, which is also seen in the beds of other rivulets between Moonapilly and Beder. These conglomerates rarely extend more than 20 or 30 yards from the present channels of the streams, and generally not above several feet. The lime contained in the water of the stream, and its tributary springs, has evidently assisted in the consolidation.

About four or five miles S.W. from Moonapilly, the low range of hills there seen was found to be of trap; the highest peak capped by a lateritic rock resembling that of Hor Muth S. of Bijopore described pp. 6 and 7 No. 2 Geological notes. This laterite near its junction with the trap passes into a bed of crimson-spotted, lithomargic earth resembling that of the Nilgherries, and is slightly impregnated with calcareous matter. The trap occupies the lowest situations, and constitutes the basis of the plain to Beder, where it is overlain by an extensive bed of laterite 200 feet thick.

*Laterite bed of Beder.*—The laterite bed of Beder commences about 16 miles ESE. from that city; it is first seen resting on the trap in a bed about 100 feet thick, forming a hill, shaped like a truncated cone, about two miles SW. from the village of Sungum. Thence it continues capping the trap with little interruption, and forming the surface rock of the level and extensive tract of table land on which the city of Beder stands. The laterite bed terminates to the west about 12 miles WNW. from Beder, descending to the plain by a short, but steep declivity and at its basis the trap is again seen. It is about 28 miles in extent from ESE. to WNW. and about 22 miles, from WSW. to ENE. Its average thickness is about 100 feet, and maximum 200 feet; it rises from the trap of the plain in abrupt, and sometimes precipitous acclivities. The cliffs supporting this table land of laterite on the northern and eastern sides, are from 100 to 200 feet high, but much lower and less abrupt on the W. side where the general level of the country appears to rise. The general direction of the cliff line, marking the termination of the bed near Beder, is E. by S. but the outline is irregular, the cliffs forming salient and re-entering angles.

The plain on the summit is almost one monotonous level, and less broken by nullahs than is generally the case on table lands. This appears in part owing to the rain water being mostly drained off through the porous structure of the rock before it has time to collect.

The height of this table land above the sea, as barometrically taken by Voysey, is 2359 feet, about 200 feet lower than the indications afforded me by means of the boiling point of water. Sheets of bare laterite impart a barren appearance to portions of its surface. The soil resulting from the disintegration of the laterite, is brown or reddish, gravelly or pulverulent, according to the varying petrographical structure of the parts of the rock of which it is composed. The soil formed from the dark and silicious varieties is usually sterile, but that from the softer and more argillaceous varieties is carefully cultivated, producing abundant *mungáí*, or early crops. The yellow *juare* and *bajra* grown on it are said by natives to be sweeter than those produced by any other soils. It seems probable that among other causes of the sterility for which lateritic soils have been abused may be ranked that of the porous character of the laterite when it forms the substratum which carries

off the water, particularly from the loose siliceous varieties of the soil, before it has had time to fertilize the surface. In the more clayey kinds of the soil the water is longer retained. In the immediate vicinity of Beder the soil does not lie thick, and the trees have a stunted appearance, particularly the mango trees that shade most of the Mausolea and Tombs in the precincts. Wherever there is a sufficient depth of soil and capability of retention of moisture, its chemical nature is certainly not against arboreous vegetation as the picturesque banyan tree, in front of the cavern spring in the *Farabagh* can testify. On the summit of the table land, a few narrow belts of the *regur* occur outcropping from the alluvium, Voysey counted four well defined zones of the cotton soil on this elevated insulation, between Beder and Shela-pilly, running N. and S. and lying between ridges of laterite, termed by him "Iron clay." The fact of its being thus found on the tops of hills, and covering the bottoms of valleys and plains, at a distance from any river's course, and out of the reach of present inundations, militates strongly against the theory of the *regur* being a fluvatile deposit as thought by some.

The principal wild shrubs growing in the lateritic soil on the surface are the *Pulas*, the *Kutlungi*, or *Chunqu Cheltu*; the *Cassia auriculata*, the *Anona squamosa*, *Asclepias gigantea*, the *Bair*, (*Zizphus Jujuba*) the *Acacia*, the *cara thorn*, and the small leafed *Burratiri*.

#### *Petrographical character of the Beder Laterite.*

The laterite of Beder, generally speaking, is a purplish or brick-red, porous rock, passing into liver brown perforated by numerous sinuous and tortuous tubular cavities either empty, filled, or partially filled with a greyish-white clay passing into an ochreous, reddish and yellowish brown dust; or with a lilac tinted litheomargic earth. The sides of the cavities are usually ferruginous and often of a deep brown or chocolate colour: though generally not more than a line or two in thickness, their laminar structure may frequently be distinguished by the naked eye. Before the blow-pipe it melts into a black clay attracted by the magnet, but is rarely so ferruginous as to entitle it to the character of an ore of iron; though some of the nodules are picked out, and smelted by the natives. The interior of the cavities has usually a smooth polished superficies, but sometimes mammillary, and

stalactiform on a minute scale. The hardest varieties of the rock are the darkest coloured, and most ferruginous. The surface masses of the softer kinds present a variegated appearance. The clay and lithomarge exhibit lively coloured patches of yellow, lilac, and white, intersected by a network of red, purple, or brown. The softness of this rock is such that it may be cut with a spade; hardening by exposure to the sun and air, like the laterite of Malabar. The surface of the harder or more ferruginous varieties is usually barren, flat like a pavement and often presents a glazed or semi-vitrified appearance. The debris of this rock washed from its surface by the rains is often seen accumulating in low situations, and reconsolidating into a nodular conglomerate; when the fragments of the laterite have been much rolled they assimilate externally to pisiform iron ore, but have neither its specific gravity, internal concentric structure, nor distinguishing lustre. The felspathic cement agglutinating these nodules is often of a deep brown colour, passing into various lighter shades according to the quantity of iron it contains, and is evidently composed of the more powdery parts of the parent rock: this alluvial laterite is seen in all lateritic areas in the S. of India and is as easily to be distinguished by its nodular and pisiform character, its position, and the thinness of its beds from the true laterite, as the reconsolidated debris of quartz, mica, and felspar is from the true granite rocks, at the bases of which it is often seen, in India, to accumulate in beds of some thickness and tenacity. In tracts where kunkur and limestone prevail, as near Bejapore and Bangwari, the lime often enters into the cement of this lateritic alluvial conglomerate.

*Sections of the laterite presented by the cliffs and wells of Beder.*

In the sections afforded by the faces of the cliffs and deep wells of Beder the laterite sometimes presents a homogeneous cellular structure from summit to base. Generally speaking however, it becomes softer and more sectile as it descends; and the cavities in the lower portions are better filled than those higher up. This may be attributed in some measure to the action of the rain, which falling on the surface percolates through the cavities of the upper portions of the rock carrying downwards much of the ochreous and lithomargic earths they contain until at length the cavities of the lower parts of the rock be-



come so full that they form an impervious bed where the water collects in hollows and cavities. Here it accumulates until it either trickles through the passes of the side of the cliff, or finds its way out by some of the nearly horizontal joints that intersect the rock. Such are the sources of the shallower wells and springs observed in the substance of laterite rocks. The deeper wells and springs are usually found at its basis where it rests upon the impervious trap. Near the line of junction the trap is almost invariably observed to be in a state of disintegration either as a friable wacke, or as a brownish or greenish grey clay. The laterite is no longer hard or porous; its cavities are broken up or filled with lithomarge and ochreous earth; and in short, it presents a dense bed of clay variegated with shades of purple, red, yellow, and white. This clayey state of disintegration of both rocks is ascribable chiefly to the collection here of the percolated water from above. The line of demarcation between the two rocks is not easy to distinguish as the clays are intermixed by the water; that of the trap is easily to be distinguished at a little distance from the contact by its greenish hue, and soapy feel, that of the laterite is often meagre to the touch, and either white, or tinged of various shades by iron. The disintegration of the trap rock rarely extends more than four or five feet below the junction.

The tubular cavities in the laterite have not unfrequently a horizontal direction; and, where numerous, impart a somewhat laminar structure to the rock. They are observed to be most numerous where the water, obstructed from passing lower down, is compelled to find its way to the sides of the cliffs; empty sinuous tubes having a general vertical direction are also observed varying from a few lines to one or two inches in diameter passing through the rock, one was traced 30 feet until it disappeared in a projecting portion of the cliff. These cavities are sometimes lined with drusy crystals of quartz. The surface of the interior is generally ferruginous and shining, and sometimes mammillary and stalactiform *veins of manganese in the laterite*. I am not aware that any writer on laterite has noticed the occurrence of veins of manganese associated with oxide of iron in this singular rock, a mineral which has probably afforded the beautiful lilac colour seen in its lithomargic earth.

At the western base of the cliffs; about 16 miles W. by N. from

Beder and  $1\frac{1}{2}$  mile from the village of Hulfergah, on the left of the road leading down from the table land into the plain, the laterite is seen penetrated by a great number of veins, which at first sight, from their dark aspect and singular direction, might be taken for those of basalt. They are composed of black, often earthy manganese, combined with iron. The veins are extremely tortuous, and crossing each other in every direction, and give a reticulated appearance to the rock. On the sides of these veins the laterite is so hard as to stand out in relief from the weathered portions of the rock. The veins are usually thicker near the bottom of the cliff, fining off as they ascend until they are gradually lost in the substance of the laterite: others are horizontal. As they diminish from an inch to a line in thickness, they gradually lose the deep bluish black colour, becoming mixed with the matter of the matrix, and pass into a brown, yellowish brown, and lastly, a purplish thread which is lost in the substance of the rock.

The bluish black substance of the veins is compact and hard, in some parts; sectile and earthy in others, easily frangible. Before the blow pipe, *per se*, it is converted into a black slag affected by the magnet; with borax it fuses into a bead of amethyst coloured glass.

The indurated sides of the veins are of a mottled reddish grey colour, resembling indurated lithomarge: portions of the greyish-white clay in their vicinity acquire an almost vitreous hardness and a cellular fritti aspect, a dull greenish enamel lines most of the cavities in the laterite: the lithomarge is slightly indurated. The fritti parts of the rock exhibit traces of calcareous infiltration. The greyish white clay fuses into a greenish enamel similar to that lining the cavities. The pure lithomarge undergoes little alteration, before the blow pipe; does not fuse but becomes indurated, darker and more mottled. The impure varieties exhibit in the reducing flame, minute greenish globules.

The lithomarge, and the greyish white, and coloured clays, all emit air bubbles, when placed in water, they also slightly decrepitate but do not fall to pieces; with water they form a plastic clay. The purer varieties of lithomarge are little adhesive, feel meagre; the streak and fracture is earthy: that of the white clays shining, feel slightly greasy to the touch.

It must not remain unnoticed that near at the base of the laterite cliff, in which the manganese veins just described occur, runs a dyke of compact and exceedingly tough basalt, occupying the space of a few

yards in breadth between the laterite and the trap of the plain. There I was unable to discover any veins of maganese either in the latter or the basalt.

The basalt of this dyke is seen, in the bank of an adjoining nullah, to assume both the globular and columnar structure.

*Valley of denudation.*—At the N. E. extremity of the cliffs of Beder an instructive example of a valley of denudation and excavation about a mile in breadth is afforded, of which the following is a Section. It shows at the same time the immediate superposition of the laterite on the overlying trap of the Deccan. (*Plate Diagram No. II.*)

A. A. Are cliffs of laterite from 120 feet to 90 feet high once evidently a continuous bed over B. B. B. sheeted trap and amygdaloid, and occupying C. C. The space D. D. hard ferruginous masses of laterite. Though evidently much waterworn and disrupted, they have successfully maintained their position against the transporting effects of the stream, which not only stripped off the laterite and denuded the subjacent trap, but excavated the latter to the depth of many feet having the hard mass *Ba.* in the centre, and the valley of denudation, and excavation D. D.

This valley runs E. by S. and over the plain at its eastern extremity are scattered the harder nodular fragments of the stripped laterite mingled with regur, and the recent lateritic alluvium of the adjacent cliffs.

*Economical uses of the laterite of Beder.*—The laterite, particularly its closer varieties, has been largely used in building the city walls; in the revetements of its ditches, wells &c. and in the construction of the more common cemeteries. The principal edifices, walls, and bastions of the fortress are of the trap. The laterite quarries of Beder resemble those on the coast of Malabar and Canara, but are deeper in consequence of the sectile beds, which are usually preferred, lying deeper below the surface than in Malabar, where the far greater moisture of the atmosphere may have some effect in preserving the moisture and sectility of the upper parts of the rock. Both rocks harden on exposure to the air. There is little appearance of stratification in the cliffs; and on the other hand, no tendency to a prismatic, columnar, or globular structure. The rock has much the appearance of those enormously thick bedded sandstones, where in cliffs even of 200 feet high there is no

alternation of other beds, and the rock appears one unstratiform trap often cleft by vertical fissures, into columns and pinnacles.

I have dwelt longer upon the subject of the Beder laterite, than it at first sight might appear to merit, but I may plead in extenuation that it is the first bed seen, beyond the granitic and hypogene area, resting on the overlying trap (a rock and the nature of the rock on which it rested had been differently stated by Malcolmson and Voysey, by the former as granite, the question however by this visit has been set at rest for ever), which probably belongs to the tertiary period. Calder to whom we are indebted for the only general view of Indian geology hitherto published, and whose ideas have been quoted by some eminent European geologists, terms laterite "a contemporaneous rock associating with trap, and commencing only where the overlying trap ends, a little to the N. of Bankote, or Fort Victoria, and thence covering the primitive rocks of the Ghauts and W. coast to Cape Comorin". Now the laterite of Beder, and many other localities, some of which will be described in the course of this paper, lies beyond the area of the rocks termed primitive by Mr. Calder, and rests *upon* the overlying trap; it has never been observed underlying or alternating with it, therefore the only proofs available, viz. that of superposition and non-alteration, tend to prove its more recent and non-contemporaneous origin; a point of great importance. The existence in it of veins of manganese and of large beds of the same mineral I afterwards discovered in the laterite area capping the granitic and hypogene rocks of the Kupputgode range in the S. Mahratta country are remarkable facts worthy of note, for until we find beds and veins of this mineral in the granitic and trappean rocks underlying the laterite we must be slow to admit the theory, advocated by several geologists, of the latter being nothing more than the result of the recent disintegration of the former rocks *in situ*. The beds of lignite discovered by General Cullen and myself in the laterite of Malabar and Travancore, and the deposits of petrified wood in the red hills of Pondicherry in a rock which though differing in structure, I consider as identical in age with the laterite, and other facts too long for enumeration here point rather to its detrital origin, like sandstones. I do not ever recollect having seen in the laterite resting on the overlying trap any fragments of the calcedonies or zeolites that often so greatly abound in the rock immediately below it, a fact which



while decisive against the decomposition *in situ* theory, would lead us to the inference that the laterite owed its origin to the detritus of other rocks than the overlying trap.

Laterite by many geologists in Europe is supposed only to fringe our coasts, and exist as a thin cap on the ghaut summits; every day however is adding to our knowledge of its extent in the interior of the peninsula, and it is evident not only that it must have covered it formerly to a much greater extent than at present; but that it has since been much broken up by the subsequent denudation of which on the small scale, Beder affords a specimen (*vide section.*) The effects of this denudation however, are visible on the grand scale in the interior of S. India, where the tops of mountains of granite, hypogene rocks, and sandstone many miles asunder are seen capped with laterite in almost horizontal beds, and little or no laterite in the intervening plains and valleys. As in Mac Culloch's description of the great denudation of the red sandstone on the N. W. coast of Ross-shire. It is impossible to compare these scattered and detached portions without imagining that the whole intervening country has once been covered with a great body of laterite, enormous masses of which have been removed by denudation. The same remarks might be applied with some modification to the subjacent sandstone. Some fragments of this great denudation may be recognized in the laterite gravel and clay which overspreads the surface of many parts of the country, and which when reconsolidated it is often difficult to distinguish from the true laterite, from which it has been derived and for which it has often been mistaken.

*From Beder to Calliany, Trap and Laterite.*

It is now time to resume our journey towards the old Jaiu city of Calliany, more lately the Metropolis of the\* Kings, a provincial city under Aurungzebe and now under the Nizam.

From the foot of the cliffs of Beder, a plain, based on trap amygdaloid abounding with calcedonies, zeolites, and calc spar, broken only by a few slight undulations, extends to Calliany near which the surface undergoes a gentle but considerable ascent, a few belts of the reconsolidated laterite gravel just described cross the road resting on the trap, and are evidently derived from some high laterite cliffs to the W. and N. of the city to which I traced the debris. On one of these

\* MSS. illegible.

heights stood a few denuded laterite cliffs about 20 or 30 feet high, insulated from each other by spaces 4 or 5 feet wide and resembling those already delineated in the Beder valley section. A piece of calcedony was picked up in the gravel but none could be discovered in the unfractured laterite. The trap, in the form of wacke, here underlies both the laterite and its detritus; the line of demarcation is perfectly defined and distinct.

*Bazaar excavated in the Laterite cliffs of Calliany.*

Nearer Calliany the bed of laterite gravel is succeeded by laterite, which forms a low ridge of hills immediately to the West of the town. A street has been cut from the rock, running along the side, about midway up the ascent, in the scarp of which a long row of now deserted houses and shops have been excavated, and also small caves supported by pillars of the laterite left untouched, while excavating. The bases of the cliffs in the vicinity are quarried for the softer variety of the laterite, which is carried off in baskets, ground with water into a plastic clay, and used as a water proof covering to the tops of the flat roofed houses of Calliany. The laterite is here called by the natives from its worm-eaten appearance *hire ka putthur*, or *siliha putthur*. The Tamuls call it *chori kulloo*, *vettic* and *culloo* and on the Malabar coast it is termed *stika culloo*.

The wells here are of considerable depth. The temp. of one, 35 feet to the surface of the water was  $78^{\circ} 5'$ —Temp. of air in shade,  $89^{\circ}$ ; the boiling point of water  $206^{\circ} 5'$ —Temp. of air  $84^{\circ}$ .

The soil between Beder and Calliany is principally lateritic mixed with the detritus of the subjacent trap crossed in a few situations by zones of *regur*, often blended with the trap and laterite soils, the low flat-topped hills avoided by the route appear to be of laterite resting on the trap.

*From Calliany to Gulburgah.*

The laterite continues from Calliany to a few miles beyond Murbi, a distance of about 15 miles, forming long flat-topped ranges of hills rising about 100 feet above the general level of the table land, and running E. S. E. They are separated by narrow flattish valleys having a similar direction to that of the hills, and to that of the wider valley

separating the Beder and Calliany laterite cliffs : they present the usual appearances of vallies of denudation, and in many places the trap and amygdaloid underlying the laterite have been exposed.

At Murbi the laterite table land of Calliany is descended to a terrace or step of comparatively level land, where the trap and its associated wacke, amygdaloids and kunker, are the only rocks met with. A little N. of Gulburgah another terrace formed by these rocks, is descended to the still lower level on which the city stands in the valley of the Bhima, about 12 or 14 miles to the N. of the present channel of this fine river. About 10 miles S. of the city, beds of limestone outcrop from the trap between the villages of Nundipoor and Sinnoor, and continue forming the bed of the Bhima at Firozabad, dipping slightly towards the S. W. The limestone continues on the opposite or S. bank of the river about 4 miles, a little to the N. E. of the village of Gownully, where it is again overlaid by the trap. (*Plate Diagram No. III.*) is a rough section from the table land of Calliany to the S. bank of the Bhima, comprehending a tract of land about 50 miles N. and S. exhibiting extensive denudation ; both laterite and trap having been stripped off the subjacent limestone exposed in the valley of the Bhima. On the South side of the valley the trap re-appears, but the softer laterite has been entirely swept away.

- |   |   |   |
|---|---|---|
| <p>A. Laterite.<br/>B. B. Trap once forming<br/>a continuous sheet.<br/>C. Limestone.</p> | } | <p>Rolled and waterworn fragments of the trap occur in, and on, the soil and gravel overlying the limestone, at a distance of two or three miles from the present channel of the river, and far above the reach of its highest floods. The traces have all the appearance of having been formed by the action of water.</p> |
|---|---|---|

#### *Iron smelting at Murbi.*

It must not be omitted to mention that at Murbi, near the edge of the Calliany table land, and the adjacent village of Boghirry, the more ferruginous nodules occurring in the laterite are collected, roasted, coarsely pounded, and smelted. The furnace at Murbi is a small one, and capable of smelting about one *Kucha* maund of 12 seers per diem. The ore is subjected three times to the action of the fire ; twice to reduce it and cleanse it from dross by beating the half molten mass

with heavy hammers; and the third time to form it into bars, and other forms convenient for agricultural implements; which are sent to Gulbergah, and Calliany. These markets are also supplied with iron from Mogumpilly in the Koil Talook. The ore, which is in the form of nodules, often exhibits, on fractured surfaces, stripes of hæmatic red earthy ore, alternating with others of a metallic iron blue. It is sold by the people who collect it to the iron contractor on the spot at the rate of  $3\frac{1}{2}$  Hyderabad rupees the Kucha maund of 12 seers.

*Lithologic character of the Firozabad limestone and Traps.*—The denuded limestone, in lithologic character, closely resembles that of Kuddapah, Kumool, Warapilly and Talicota, no fossils were found in it. The prevailing tint is a greyish blue, strings of small spherical cavities occur in it as in the limestones just alluded to, some empty, others filled with a brown ferruginous dust.

The trap has often a porphyritic structure, imbedding crystals of a dull olive green mineral, which in disintegration assume a greenish-brown tinge, and finally fall out, leaving cavities in the rock. They are not unlike some varieties of olivine, a mineral occasionally seen in this trap; a great development of kunker is observed in its fissures previous to coming on the outcropping of the limestone.

*The Bhima River.*—The Bhima is about 600 yards in apparent breadth at Firozabad, its temp.  $78^{\circ}$  Faht. temp. of air  $90^{\circ}$ . Approximate height of bed above sea by boiling point 1730 ft. The waters were swollen and muddy from the Monsoon rains (June) and running at the rate of  $2\frac{1}{2}$  feet per second. A tumblerful of the water deposited about  $\frac{1}{12}$ \* its bulk of a fine reddish brown sediment, which effervesced with dilute sulphuric acid, evidently the debris of the trap, amygdaloids and limestone rocks, over which it passes. The banks are shelving, and composed of the laminar greyish blue laminar limestone covered with silt and *regur*, and their surface strewn to a considerable distance on either side with rolled fragments of agates, calcedonies &c. marking the extent of the floods.

The bed has been hollowed in the limestone, exposing shelving surfaces of the rock, in some places perfectly bare, others covered with silt or a gravel from the size of a pea to that of an egg, fragments of trap, and limestone, calcedonies, jasper, and agates. In consequence of the

\* So in MSS.



disorders committed by the irregular Arab soldiery, the town of Firozabad had been almost deserted: and the *ambikars* with their basket boats had quitted the ferry which was now unfordable and the water running with considerable rapidity. The village people collected a number of pumpkins, and about noon they succeeded in netting these together and constructing a tolerable raft, with which the stream was easily crossed.

The sources of this fine river rise in the western ghauts a little to the N. and S. of Poonah; after watering the fertile plains of the country of the Marhattas, where its banks are famous for the breed of horses and mares from which the hardy cavalry of this warlike race has been chiefly supplied, and flowing S. Easterly towards the Bay of Bengal over the almost continuous sheet of the great overlying trap formation of the Deccan, it joins the Kistnah on the granite and hypogene area of Hyderabad about 50 miles direct distance S. E. from Firozabad. It contributes to the Kistnah many of the *Pietri duri* of the overlying trap formation that are rolled along its bed over more than half the peninsula.

*Trap Formation from the right bank of the Bhima to the laterite of Inglisswara.*

The trap again covers the limestone a little to the N.E. of the village of Gonnully, about 4 miles from the river: the latter rock is seen outcropping for the last time at the base of a low hill of trap between Gowncolly and Sunnoo. The trap is amygdaloidal, veined with kunker, and imbedding calcedonies and calc spar.

From Sunnoo to Jyattaky the calcedony is seen both in veins and nodules, and passes into plasma; the colour varies from the lightest tinge of apple green to the deep hue of heliotrope into which it passes; in some translucent varieties the colouring matter is desposed in delicate moss-like filaments, the colouring matter of the plasma has not been exactly ascertained by chemists, but it seems to be similar to that of the heliotrope, both disappearing before the blow-pipe.\* The colour of this variety of plasma when exposed to the reducing flame changes to a purplish white, the plasma becoming opaque and easily frangible. I have little doubt that the red spots of the variety of Calce-

\* Perhaps silicate of Iron? that of Heliotrope being the red oxide?—Eds.

dony termed heliotrope are derived from thin beds of fine bright red bole which are often seen alternating with the trap, and in nests, in this vicinity.

The surface of the country to Sindaghi presents the long, low, flat, step-like elevations of trap, separated by plains along which the route lies, and running in a S.E. direction. The soil is usually the detritus of the trap and laterite in belts and patches of a grey colour, and dark red, sometimes sandy; the vegetation stunted consisting chiefly of the Acacias the *Cassia Auriculata* and *Hingun* thorn. On a fallen blighted acacia amid the low jungle I observed a chameleon perched motionless, with his head erect and jaws wide open, as if indeed making a meal of the afternoon breeze. His skin, which mimics the prevailing hues of surrounding objects; blue when basking beneath a cloudless sky, and emerald when shaded by the forest's verdure, had here so strongly assimilated that of the black and ashy white stem on which he lay, that at first I thought it was a singular excrescence of the wood itself.

A little to the N. W. of Sindaghi the summit of a ridge is observed covered with globular masses of a compact basaltic trap, underlain by a bed of the fine red clay imbedding a profusion of Zeolites, also heliotrope, plasma, geodes of calcedony lined with quartz, crystals, semiopal, cacholong agate, and calc spar, resting on a greenish grey wacke. Both rocks are veined and interstratified with Kunker of a somewhat cancellar structure. The horizontal layers of Kunker are often from 10 to 12 inches thick. The softer wacke and amygdaloid, in weathering often leaves the harder layers of Kunker projecting from the surface. (*Plate Diagram No. V.*)

A Globular basaltic trap. B Red amygdaloid. C kunker layer. B red amygdaloid. C Kunker layer, D Wacke.

From Sindaghi by Ipperghi to Ingleswara, the aspect of the country is much the same as from the Bhima to Sindaghi, but the plains become flatter, more extensive, and more intersected by nullahs. At Ipperghi the trap assumes the rich brownish purple or chocolate hue of the trap of Bejapore, and is seen in the bed of the rivulet resting on a beautiful red zeolitic amygdaloid: the line of contact is marked and distinct: heliotrope and plasma are less common here.

Indications of the laterite are perceived before reaching Ingleswara in beds of its detritus re-cemented by a brown ferruginous and calcareous paste, also fragments of chert and a variety of limestone por-

phyry. As anticipated, the laterite was found capping a ridge of trap and wacke a little to the S. W. of Ingleswara presenting a similar development of the lithomarge near the line of contact with the trap as observed at Beder. The latter rock passes into a friable greenish wacke, and also into a dark amygdaloid containing spheroidal cavities, often filled or lined with green earth.

The hill of Ingleswara, marked by an old tower, is principally composed of wacke penetrated by flattish, apparently compressed, veins of fibrous arragonite. On the top of the hill are scattered globular and angular fragments of basaltic trap; while partially imbedded in the soil covering its sides, are rough, scabrous-looking blocks of a light coloured rock, resembling altered limestone passing into chert. These blocks are mostly angular, from generally 6 inches to two feet thick, have a whitish exterior so rough in aspect and touch as, in these respects, to resemble trachyte, and when fractured the small glistening, red, and white calcareous crystals they imbed, might at first sight be taken for those of glassy felspar. The softer and more crystalline portions of this singular rock effervesce with acids. It occurs also, in detached blocks, on the wacke at the base of the laterite cliffs S. W. of Ingleswara. The rock here is more compact, homogeneous, less crystalline in structure and exhibits dark dendritic delineations. Some fragments are partly coated with a thin bluish white enamel, which is apt to assume a botryoidal form; on its surface are seen numerous small white globules of white enamel. Among the lateritic debris intermingled with these blocks are interspersed numerous nodules of a black cineritious looking mineral, containing cavities filled with an impure, earthy, brown manganese; their black outer crust is often so indurated as to give fire with steel. Before the blowpipe, *per se* it reddens slightly and exhibits minute globules of a bluish white enamel.

The following section will exhibit the position of these blocks of cherty limestone as they occur on the sides of a valley of denudation and excavation, a mile in width. (*Plate Diagram No. IV.*)

A. Laterite, overlying trap at B. and stripped off at E and B. b.

B. B. b. Trap.

C. Globular basaltic trap.

D. D. Blocks of whitish scabrous limestone passing into dust and half imbedded in lateritic gravel.

E. Valley of denudation and excavation.

The Limestone has very much the appearance of the freshwater limestone of Nirmul, Moonapilly, and Koolkonda between Gulberga and Muctul, and has evidently been broken up and altered by the basalt. The angularity of the fragments and their little waterworn appearance, prove that this bed must have been deposited, and existed *in situ*, at no great distance from the present locality. The blocks were not observed in the centre of the valley, from which it may be inferred that the limestone was only a littoral deposit, or that its fragments were carried away by the aqueous current by which the valley was excavated. The laterite cliffs of Ingleswara like those of Beder, Sondur, and on the western coast, are cavernous: one of the caves near the summit, is held sacred by the Hindoos. The entrance was barred by a locked gate; it is said by the natives (credat Judæus) to communicate with another similar cavern on the hill of Nageswar, also said to be of laterite, about three coss to the S. W. Near the mouth is one of those remnants of the strange ophitic adoration that prevailed over great part of S. India, in the shape of an image, of which the upper portions resemble those of a young female, and the lower terminating in the coils of a serpent.\* Ingleswara is famed in Hindoo annals as the place where the nuptials of Buswapa the founder of the great sect of Jungums and Singayets, and the overthrower of the Jain dynasty of Calliany, were celebrated. The small laterite hill of *Hori muth* his birth place, is at a little distance.

From Ingleswara to about 11 miles S. W. of Bagwari, trap, wacke and amygdaloid form the basis of the plain where its southern limit is again crossed to the hypogene area. A reddish felspathic zone, similar to that already noticed in the Bejapore notes, intervenes between the trap and the gneiss, which is first seen to outcrop in the bed of a nullah between the villages of Hungraghi and Wondal, where a section is afforded showing the thinned-out edges of this great couléé of trap resting on and coating the reddish intervening felspar zone. This zone, or salbande, is probably nothing more than the altered gneiss.

The mica in the gneiss is replaced by hornblende and at a little distance, the gneiss passes into hornblende schist. Both rocks are highly inclined, dipping westerly; gneiss, felspathic veined and interspersed

\* We have in the Museum a *double* image of this kind formed by two female busts with serpent terminations.—Eds.



with quartz continues to the left or N. bank of the Kistnah to Chimlaghi where it disappears under beds of a bluish limestone resembling that of Firozabad. The gneiss is in some situations capped by laterite fragments of a greyish blue and buff limestone; the latter crystalline and effervescing feebly with acids, and penetrated by tortuous veins of the dark chert. A few globular boulders of granite and greenstone are scattered over the low hill of Chimlaghi, out of the reach of the floods of the Kistnah. They have a rugged waterworn exterior. The hill itself is capped with a layer of kunker, varying in thickness from a few inches to five feet, imbedding nodules of a ferruginous clay and angular fragments of a grey and dark coloured chert, a bed of which is seen intervening between the limestone and the gneiss. The kunker bed rests upon disturbed strata of the bluish limestone, so much broken up that it was impossible to ascertain the dip, or direction of the rock. The gneiss underlying the limestone imbeds crystals of calc spar.

From the junction of the Kistnah, and the Gutpurba near Chimlaghi, by Kulladghi, to the West of the falls of Gokauk on the eastern flank of the Western Ghauts a limestone and sandstone formation supposed to be identical with those of Cuddapah and Warapilly, extends, with partial outcroppings of the hypogenes, and a few patches of overlying trap and laterite. The nature of the rocks composing the summits of the Ghauts immediately behind the falls of Gokauk have not been noticed. A little further south they are composed of the hypogene schists and granitic rocks covered, partially, to the Sea at Goa, Vingorla and Malwan by laterite. North of Malwan the overlying trap is almost the exclusive rock seen to Surat. Of the geology of the Southern Mahratta country I intend speaking more fully in a subsequent paper.

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*Proceedings of the Asiatic Society, for the month of DECEMBER, 1844.*

The monthly Meeting, which had been unavoidably postponed, was held on Tuesday evening, the 17th December, 1844.

The Rev. J. Hæberlin, in the Chair.

The following members proposed at the last meeting were balloted for and declared duly elected :—

Jas. Alexander, Esq. C. S.

Jas. Furlong, Esq. Mulnauth Factory.

And the following gentlemen were proposed as Members :—

F. Boutros, Esq. Principal of the Dehli College, proposed by E. C. Ravenshaw, Esq. C. S., and seconded by W. C. Quintin, Esq. C. S.

A. Christopher, Esq. of LaMartiniere, proposed by Major General Hodgson, and seconded by H. Torrens, Esq.

Lewin Bentham Bowring, Esq. C. S., proposed by Major General Hodgson, and seconded by H. Torrens, Esq.

E. Blyth, Esq. Zoological Curator, Associate Member, proposed by H. Torrens, Esq., and seconded by H. Piddington, Esq.

John Ward, Esq. Messrs. Jessop and Co. Civil Engineer, proposed by Lieut. Col. Forbes, B. E., and seconded by Captain Goodwyn, B. E.

A. W. Steart, Esq. B. M. S.,\* proposed by George Hill, Esq., and seconded by H. Torrens, Esq.

Read the following list of books presented and purchased :—

*Books received for the Meeting of the Asiatic Society, Tuesday 17th December, 1844.*

*Books Presented.*

1. The Horn Book of Storms for the Indian and China Seas, by H. Piddington, from the author.

2. Notes on the Naga Tribes in Communication with Assam, by John Owen, by the author.

3. Zeitschrift für die Kunde des Morgenlandes, herausgegeben von Christian Lassen. Sechsten Bandes Erstes Heft 1844. By the author.

\* *Memorandum.*—In the case of this gentleman who was on the point of embarking for Europe, it was proposed to proceed immediately to ballot but the sense of the Members present, being decidedly against such an innovation on the established rule the proposal fell to the ground.

4. Calcutta Journal of Nat. History by J. McClelland, Bengal Medical Service, 2 Nos. 16 and 18 for January and July 1844, and a Complete set in exchange for the Journal of the Society, from the date of the Commencement of the Journal of Natural History.

5. Journal of the Agricultural and Horticultural Society of India, vol. iii, part ii, by the Society.

6. Calcutta Christian Observer for December 1844, by the Editor.

7. Supplement Calcutta Christian Observer, by the Editor

8. The Oriental Christian Spectator, November 1844, by the Editor.

9. The Palms of British East India, by Dr. Griffith.

10. Proceedings of the Royal Society for

1838 Nos. 31 to 36.

1839 „ 37 to 41.

1840-41 „ 42 to 46.

1842 „ 47 to 55.

1843 „ 57 to 58.

11. Proceedings of the Calcutta School Book Society. Reports 1st to 10th and 12th, by the Rev. Mr. Long.

12. Description of some nondescript insects from Assam, by the author, W. Griffith, Esq. M. M. S. 2 copies.

13. Philosophical Transactions of the Royal Society of London from 1838 to 1843, 6 vols. and part I of 1844, by the Society.

14. The Royal Society for November 1841, and November 1843, by the Society.

15. Meteorological Register, kept at the Surveyor General's Office, Calcutta, for October and November 1844.

#### *Books Purchased.*

16. Researches into the Physical History of Mankind, by J. C. Prichard, vol. 4.

17. The Annals and Magazine of Natural History, including Zoology, Botany, and Geology, vol. 14, Nos. 90 and 91.

18. Journal Des Savans, August, 1844.

19. The Athenæum for September 14th, 21st and 28th, 1844.

20. The History of Etruria, by Mrs. H. Gray part I.

21. A Manual of Ancient History. Translated from the German of A. H. L. Heeren.

22. Geography of Arabia, by G. Foster, 2 vols.

23. Classical Museum, Nos. 2, 3, 4 and 5.

Read the following letters from the Society's London Agents and booksellers:—

*To H. PIDDINGTON, Esq. Secretary of the Asiatic Society Calcutta.*

SIR,—We have the pleasure to acknowledge the receipt of your letter of the 14th July, enclosing a bill of lading for a case of books shipped on board the *Lady Flora Hastings* for the Asiatic Society of Paris. On the arrival of the vessel the case shall be forwarded to the Society agreeably to your instructions.

*London, 10th September, 1844.*

WM. H. ALLEN & Co.

To H. TORRENS, Esq. &c. &c. &c. *Secretary to the Asiatic Society of Bengal.*

SIR,—We have the pleasure to advise you of our having forwarded by the ship “Tudor,” to your address, care of Messrs. Ostell and Lepage, a case of Books for the Society which has been received from Trinity College, Dublin, with a request that it might be forwarded to the Asiatic Society by an early opportunity. We have no doubt you will have heard from Trinity College, respecting the same ere this.

By the same ship we have likewise forwarded to your address a small box containing shells, &c. which are presented to the Society by Dr. Vandem Busch of Bremen. The Dr. will be much obliged by your acknowledging the same. We have paid fifteen shillings, expences on the box from Bremen, which we shall charge in our account.

Messrs. Ostell and Co. have been requested to deliver the cases to the Society as soon as they reach them.

*London, 2d September, 1844.*

WM. H. ALLEN, AND CO.

An application having been made by Mr. H. M. Smith, the artist employed in reducing and lithographing the fine coloured map of the Nerbudda river, which appeared in No. 153 of the Journal, for a small gratuity above his contract, on the ground that the work had been more difficult and costly than he at first expected, and some difference of opinion having arisen in the Committee of Papers, as to the propriety of according this increase, it was referred to the Society, who voted Mr. Smith a gratuity of 25 rupees above the amount of his bill.

Read letter from the Officiating Secretary to the Government of India:—

No. 588.

*From T. R. DAVIDSON, Esq. Officiating Secretary to the Government of India, to H. TORRENS, Esq. Vice President and Secretary Asiatic Society, dated the 30th November 1844.*

Home Department.

SIR,—I am directed to acknowledge the receipt of your letter of the 11th Instant, with its enclosure, and to communicate the desire of the Right Hon’ble the Governor General in Council, that the Asiatic Society will be good enough to forward to this Department 25 copies of the Memoir\* therein referred to.

*Fort William, the 30th Nov. 1844.*

T. R. DAVIDSON,

*Offg. Secy. to the Govt. of India.*

From the Secretary of the Military Board:—

No. 3,954.

To H. TORRENS, Esq. *Vice-President and Secretary of the Asiatic Society.*

SIR,—I am directed by the Military Board to acknowledge the receipt of your letter dated the 6th current, and to state that application should be addressed to

\* On the navigation of the Nerbuddah river with a map, see Journal No. 1833. One hundred copies were also forwarded for the Government of the N. W. P.

Government for Lieut. Yule's papers on the Coal Formations at Cheera Poonjee, as without previous sanction, the Board are not at liberty to grant copies (or originals) of any public documents.

2. The Board desire me to express their thanks for the very polite and liberal offer of the map and memoir of the course of the Nerbudda, by Lieut. Shakespear, and request to be favoured with 6 copies, if so many can be conveniently spared.

*Fort William, Military Board*

*Office, 25th October, 1844.*

J. GREEN, *Secretary.*

From the Secretary to the Government of North West Provinces :—

No. 901.

*From A. SHAKESPEAR, Esq. Asst. Secy. to the Government N. W. P. Agra, to H. TORRENS, Esq. Secy. Asiatic Society Calcutta, dated Agra, the 2d Oct. 1844.*

Genl. Depart. N. W. P.

SIR,—I am directed to acknowledge the receipt of your letter of the 10th ultimo, and to state that His Honor will be glad to receive 100 spare copies of the Note on the Nerbuddah, and of the map of that river at the cost price.\*

*Agra, the 2d Oct. 1844.*

A. SHAKESPEAR.

*Asst. Secy. to the Govt. N. W. P.*

No. 1031.

*From A. SHAKESPEAR, Esq. Asst. Secy. to Govt. N. W. P., to the Secy. Asiatic Society, Calcutta, dated the 5th Nov. 1844.*

Genl. Depart.

SIR,—I am desired to place at the disposal of the Asiatic Society for publication in their Journal, the accompanying "Notes on the subject of the Kamaon, and Rohilcund 'Turaee,'" compiled by J. H. Batten, Esq. Senior Assistant Commissioner, Kamaon proper.

*Agra, the 5th Nov. 1844.*

A. SHAKESPEAR,

*Asst. Secy. to Govt. N. W. P.*

From the Secretary to the Government of India :—

No. 792, of 1844.

*From F. CURRIE, Esq. Secy. to the Govt. of India, to the Secy. to the Asiatic Society, dated Fort William, the 9th Nov. 1844.*

Foreign Depart Secret.

SIR,—By direction of the Governor General in Council, I have the honor to transmit to you for such notice as the Society may deem them to merit, the accompanying papers received from Major R. Leech, C. B. containing information of certain countries little known to Europeans, lying beyond the Indus and Cabool rivers.

2. You will be pleased to return the original papers when no longer required.

*Fort William, the 9th Nov. 1844.*

F. CURRIE,

*Secy. to the Govt. of India.*

\* No charge is made by the Society for these returns for the courtesy of Government, the Society considering it as one of its first duties to aid as much as possible in all matters connected with the public service or the diffusion of knowledge.—EDS.

No. 802 of 1844.

*From F. CURRIE, Esq. Secy. to the Govt. of India, to H. TORRENS, Esq. Secy. to the Asiatic Society, dated Fort William, the 16th Nov. 1844.*

Foreign Depart. Secret.

SIR,—I am directed by the Governor General in Council to transmit to you, for such notice as the Society may deem them to merit, the accompanying papers received from Major R. Leech, C. B. containing information regarding the Hazarehs and the early Ghilzaees.

2. You will be pleased to return the original documents for Record in this office when no longer required.

*Fort William, the 19th Nov. 1844.*

F. CURRIE,  
*Secy. to the Govt. of India.*

From the Under-Secretary to the Government of India:—

No. 805, of 1844.

*From W. EDWARDS, Esq. under Secy. to the Govt. of India, to H. TORRENS, Esq. Secy. to the Asiatic Society, dated Fort William, the 16th Nov. 1844.*

Foreign Depart Secret.

SIR,—I am directed by the Right Hon'ble the Governor General in Council, to transmit to you, for such notice as the Asiatic Society, may deem them to merit, the accompanying papers received from Major R. Leech, C. B. containing an account of the early Abdhalees, and notes on the religion of the Sikhs.

2. You will be pleased to return these documents for record in this office when no longer required.

*Fort William, the 16th Nov. 1844.*

W. EDWARDS,  
*Under Secy. to the Govt. of India.*

The papers received from Government with the foregoing communications were referred to the Editors of the Journal for publication or extracts.

Read the following memorandum by the Sub-Secretary:—

*Memorandum.*

In a letter to the Sub-secretary of August last, the Right Hon'ble Sir Edward Ryan says,

“The picture for the Asiatic Society is, as far as I am concerned, finished, the artist is Mr. Laurence. It might be completed, and dispatched in January next, (until then, there will be no good ship, and the season is unfavourable,) but the artist may try to keep it for the exhibition which I shall endeavour to prevent. The picture for the Asiatic Society has been seen by Mr. Thoby and Mr. William Prinsep.

I am happy to tell you that Mr. Lay, has nearly finished an admirable likeness of Mr. Thoby Prinsep, for the Asiatic Society.



A complete copy of ABDUL RUZZACK'S DICTIONARY OF THE TECHNICAL TERMS OF THE SUFIS, edited in the original Arabic by A. Sprenger, Esq. M. D. B. M. S., and printed at the expense of the Society, was on the table as a work finished and to be published in a few days.

The following extract of a letter from Dr. Sprenger, relative to it was read :—

I put "to be sold by Allen and Co." in the title page, I wish that arrangements might be made to have the Society's books sold at all these places, (particularly by Brockhaus who besides Germany, provides Russia and Italy with books,) in order to make them known and more generally useful, I know all the parties personally, and if you like I will be your *chargé d'affairs* in concluding treaties of commerce with them.

A. SPRENGER.

*Chinsurah, November 30th 1844.*

Read the following note from the Secretary : and it was referred to the Committee of Papers to recommend the number of copies, for which the Society should subscribe :—

Dr. Hæberlin announced, through the Secretary, his intention of publishing a Sanscrit Anthology consisting of fifty brief, but choice specimens of the best school, that of Kali Dasa, of Sanscrit poetry, didactic, elegiac, and other. This offers to the Sanscrit scholar a description of work as yet a desideratum in the learned world, a book namely which may enable him to study in brief, and at small cost, the best, and choicest classical styles of eminent writers in that ancient and admirable language. Dr. Hæberlin proposes to publish the work himself, but in communication with him, the Secretary suggested to the Society their taking a certain number of copies of it. It will prove a most valuable book to the Society for the purpose of distribution to learned bodies, and individual scholars in correspondence with it. The copies will be delivered at trade price. He stated that he was not prepared to note at present the number of copies to be taken, but after making a list of quarters in which they might be distributed, and a reasonable stock of reserve copies, the Secretary said he would have the honour of laying that list, definitely numeralised, before the Society if the general proposition be favourably received.

Read the following letter from the Zoological Curator :—

*To the Secretary of the Asiatic Society.*

SIR,—I wish to call your attention to the necessity that exists for some further assistance in my department of the museum. It is to no purpose that I devote more than double the number of hours to the business of my office, than were stipulated at the time I took charge of the Museum ; and that I devote my *undivided attention* to those duties, without receiving any additional remuneration for thus labouring so many extra hours daily. In consequence chiefly of those exertions, the labour in my particular department has increased to that degree, that it is impossible for any one person, or even for two or three, to get properly through it. What with corresponding, the necessity of attending visitors who manifest an interest in the Museum,

and a variety of current business of daily urgency, I find it impossible to make that progress, which I wish and desire, not only in the preparation of the letterpress to accompany the publication of Burnes' drawings, but in various other matters which it is desirable should meet with every attention. There is, indeed, abundant occupation for one naturalist in the entomological department, whether or not comprising the whole of the annulose animals; and there is equal occupation for another in the investigation of Indian mollusca and other *Invertebrata* exclusive of the annulose animals. But, for the present, a good deal of assistance might be rendered to me by the appointment of a youth, whom I have for some time past employed in writing labels, and doing other work of the kind, and who might be engaged as a general assistant to me for a salary of 10 or 12 rupees a month to begin with, promising an advance in case of his affording satisfaction after a sufficient trial. It is quite necessary also that some addition should be made to the number of servants in my department. At present there is only one old man, who is quite superannuated, and I am constantly obliged to employ my own private servants in the Society's business. There is full employment for two additional servants, one as a messenger, and the other to assist in cleaning the specimens, glasses, &c.: the fact being, that the place of one who left some six months ago has never been filled up, his work having been since performed chiefly by lads who are now distributed over the country in the capacity of taxidermists, assisting different gentlemen who are active contributors to the Society's museum. Leaving these matters to your consideration,

17th December, 1844.

I beg to remain, Sir,

Yours very respectfully,

E. BLYTH.

Referred for discrecional intercourse with the Secretary.

Read the following references to and from the Committee of Papers, and papers connected with them, on the subject of Major Jervis' proposal to execute glyptographs and lithographs for the Society:—

I have to circulate the extract accompanying.\*

For my own part I think it in some sort our duty to patronise, and encourage local artists rather than go to England for our illustrations. If the Society are satisfied with what has been done hitherto, I may perhaps be directed to write to Major Jervis accordingly.

December, 6th, 1844.

H. TORRENS,

V. P. &c. &c.

*Memorandum by the Sub-secretary.*

MY DEAR TORRENS,—Looking at your note for the circulation of Major Jervis' letter and specimens of Lithography, the following views occur to me which the Committee should also I think bear in mind.

\* See Proceedings of November.

1. The great merit of every pictorial work is, that it be either a faithful representation, or a faithful *copy* of the original representation when it is to be multiplied by the press: for from the moment that an artist is permitted to *improve* a drawing or a sketch, unless he does so under the eye of the person who first made it, the chances are a hundred to one that what it gains as a picture it loses as an honest copy of what was done on the spot. Major Jervis' lithograph of the Argemone Mexicana seems to have been subjected to *improvement*. It is too elegant for our common *Shial Kanta*. We know that this has been carried to such a length in Europe that naturalists are now much occupied in divesting publisher's *pictures* of their artistical improvements, by referring back to the original drawings, however faulty these may be in many points.

2. We have rarely, if ever *first rate* sketches or drawings in India, though we often have them good, and spirited, and conveying a vivid idea of the place, plant or animal, &c. and we have sometimes the advantage of having the naturalist on the spot to correct his own work\* or shew the artist how far he may do it for him. By sending to Europe we at once lose this important advantage.

3. If we had always *first rate* drawings we might perhaps with truth say we could not do justice to them. But I submit that, hitherto, we have most certainly given *most accurate copies of what we had to copy from* ? and that the question is really, situated as the Society is, not if we can give first rate work, but if we can give five hundred *exact copies* of the works put into our hands: I do not allude here of course to the cheapness or dearness, distance, loss of time, risks of loss, (or must we keep duplicates ?) &c. &c. &c.

4. Again. The Society is always *in trust* for these matters. Are we justified, I should ask, in trusting out of our safe custody the labours of others ? And this in the face of the many reports which we hear of the eager rivalities of European naturalists ? How *could* the Society for instance send Dr. Cantor's Chusan drawings or those of Burnes, &c. to Europe ?

5. As far as I am concerned it would be a great load of work taken off my file, for you know what artists, and printers, and authors here are ; so that I am really interested that all the work *should* be sent to England !

6. I venture then to request of you, for I think it will assist the Committee in forming their judgment, to circulate with Major Jervis' proposal, the following copies with originals, which are in various styles, and which have not yet been seen together by the Committee.

The Burnes' drawings have already been exhibited, and as coloured lithographs have been pronounced most creditable work, and most faithful copies.

European Artist, { 1. Dr. Griffith's Botanical plates to Cantor's Chusan Zoology, 4  
Mr. Bennet, { drawings.  
                              { 2. Plate 1 of Dr. Cantor's Chusan Zoology, *Vespertilio irretitus*.

Native Artist, .. 3. Lt. Yule's two Kasia Hill drawings.

European Artist, { 4. A jaw and teeth from Dr. Spilsbury's Fossils.  
Mr. Bennet, .. {

Native Artist, .. 5. Siamese Emperor, Col. Lowe, 2 drawings.

7th December, 1844.

H. PIDDINGTON,  
Sub-Secretary, &c.

\* As in the case of Dr. Griffith with his Botanical Plates to Cantor's Chusan Zoology. See subsequently his letter.

The accompanying papers with a memorandum from the Secretary are re-circulated by his desire, and the specimens of our work as ready for the Journal and Researches.

H. PIDDINGTON,

*Thursday Noon.*

*Sub-Secretary Asiatic Society.*

I beg to re-circulate these papers.

It is easy to advocate the acceptance of Major Jervis's offer, but not so facile to explain to the Editor of a monthly Journal how he is to satisfy his contributors by speedy publication of their illustrated papers, as well as to insure them against risk of loss of their original drawings when the publication of their articles, and the very conservation of their originals, is contingent upon the hazards of a transmission to England to a third party?

To put the matter as fully as possible before the Committee, I circulate the specimens or proof lithographs of drawings now on hand for publication in the Journal and the Researches, with their originals. The botanical lithographs are to illustrate Dr. Griffith's paper for Cantor's Chusan.

I submit that these local productions are rather above the average of such work for scientific periodicals, and although inferior to Major Jervis', yet respectable and even creditable to the Journal, and not unworthy the Researches.

I trust the Committee will not make the difficult task of editing a scientific Journal in India, next to impossible, by requiring illustrations of papers published monthly to be prepared in a country whence, at the shortest, I could not get them under five months.

The preparation of plates for the Researches by Major Jervis is I think most expedient.

H. TORRENS,

*V. P. and Secretary Asiatic Society.*

*Additional Memorandum by the Sub-Secretary.*

Between the first and second circulation of the papers relative to Major Jervis' proposal, thinking that the opinion of a scientific man, himself an artist, of experience in Indian scientific publications, and well acquainted with the business details as well as the tricks which are, it is said, sometimes practised in these matters, would be useful, I wrote to Dr. Griffith, then on his way down the river, on the subject. I unfortunately did not keep a copy of my letter, but I was very careful not to say any thing which could bias him either way; stating only that as it had been proposed, and was now under consideration, to send drawings home for lithographing for the Society's publications I should be glad to have his opinion of this proposal as regarded the interests of men of science, the risks of the drawings, copying here, &c. &c. and the style of execution of Calcutta artists; his answer is as follows:—

MY DEAR SIR,—I think the state of copying drawings in Calcutta, promising enough to entitle Calcutta artists to patronage; two or three more attempts, and their copies would be equal to most of the drawings in ordinary periodicals, and at any rate be quite equal to properly illustrating the subjects.

Scientific drawings require scientific superintendence even in England, and to have one's drawings copied away from one would be nearly as bad as having one's MS. printed while one is absent. No. 1. of mine is very fair; the faults of the others are faults of the drawings which were not bold enough. This arose from inexperience on my part; I am quite certain that very creditable drawings can be made in Calcutta. with ordinary care on the part of authors and proper supervision of the artists. Therefore I would not send drawings home, myself unless a very high degree of finish was required.

Kedgerie, 15th December, 1844.

Your's  
(Signed) W. GRIFFITH.

After some discussion it was resolved :—

That as an experimental measure plates for the Researches be generally referred to Major Jervis, and those for the Journal be generally executed here.

It was mentioned that Mr. Heatly had addressed a letter to the Secretary embodying some remarks on the want of connection between Home and Indian Scientific Societies, and submitting some views as to a remodelling of the present working system of the Society, but no definite proposal being brought forward, discussion was for the present necessarily postponed.

*Report of the Curator Geological and Mineralogical Departments and of the Museum of Economic Geology, for the month of October.*

*Geological and Mineralogical.*—We have this month to announce the highly interesting discovery by our zealous member and contributor Captain Newbold, of Bone caves in Southern India, and I cannot better do so than in the words of his letter.

Captain Newbold writes from Kurnool as follows :—

“ Enclosed is a brief note of some of my late labours, pray correct any thing wrong I really have hardly time to write.

If similar cave deposits have hitherto been not discovered in your part of India, kindly notice the fact in an Editorial note. These are the first fruits from Southern India, have you got hold of Voysey's unpublished notes and map? if so, please let us in South India who are much interested, have the benefit by an early publication.”

His description of the Bone Caves will appropriately form an article for the Journal.

Dr. Rowe of the Artillery at Dum-Dum, it will be recollected, referred to the Museum for the identification of a few specimens of minerals which he had collected on the old Benares road on a march down.

In replying to him I requested specimens of the Corundums for the Museum, and some account of the locality if he could oblige us with one. He has been good enough to place at our disposal a very carefully kept itinerary of that road, which affords so many



useful hints to the Geologist and Mineralogist, that I should strongly recommend its publication. Though Dr. Rowe modestly disclaims any scientific merit in it, yet it evidently is the production of a gentleman who knew what he saw, and made the best use of the brief moments a military march allows to a medical man. It were much to be wished we had many such observers and tracks, for they would give us, if not correct sections, much useful Geological information, particularly if specimens of the rocks were collected and the inclination of the strata seen were noted.

I have completed the catalogue of Mr. Dodd's specimens which form a very handsome and instructive case in our Geological collection. The catalogue should be printed as the best means of preserving a record of it: and of the Society's property.

Dr. Spilshury has sent us some more specimens of his sandstones with arborescent impressions, some of which are not superficial but go *through* the slab; and he inclines to think they may be fuci. I have tried both with the blowpipe, and the superficial ones are oxide of manganese; those penetrating these specimens are iron, and if they ever were organic there are now no traces of organic matter remaining; but in discussing this curious question, as far as I recollect, it seems to have been forgotten that it is not impossible the iron and manganese may yet be the remains of organic bodies, as for example the deep-sea fuci, of which we know nothing.

Mr. Dodd of the mint, on his departure for the Cape, has favoured us with a few specimens of sandstone and limestone from the Bhurtpore and Kerowlee Territory, of which his letter speaks as follows:—

I send you a few more specimens of sandstone from the Bhurtpore Territory.

A few specimens of limestone from the Kerowlee Territory, (the country where this limestone is found abounds with caverns and waterfalls, and I imagine it belongs to the Magnesian limestone formation) from Kerowlee, a fragment of coal was brought me when at Agra. There are also a few specimens of sandstone with ripple marks on them, also a few specimens of red sandstone, with what I imagine to be encrinital marks in them.

I thought these might be interesting as connected with some paper in the Asiatic Society's Journal.

5th November, 1844.

JAS. DODD.

P. S.—You will find some of the sandstone specimens contain casts of shells.

I have not had time to examine the shells of which he speaks. The mottled impressions on the sandstone are certainly not encrinital as far as I can perceive, and are, I think much more probably, as in other cases in Europe, and as suggested by a writer in the *Annals and Magazine of Natural History*, the result of some animal or vegetable substance discolouring the red iron tint of the original sand. Dr. Voysey *As. Res.* Vol. XV. p. 429, says of the Agra mottled sandstones that the spots are really spherical, and these appear also to be so in some places.

*Museum of Economic Geology.*—I may mention here that I sent some of our Museum circulars to my brother, who is much connected with Civil Engineers. He writes to me "My friend Sopwith writes to you by the 15th September mail. We are having 250 copies of your circular printed for distribution, Mr. Sopwith says he is sure Sir H. De la Beche, takes the greatest interest in the success of the Asiatic Society and Indian Museum, and has shewn him your report, but Sir H. De la

Beche really is overwhelmed with work which he is sure is the only reason why you have not heard from him."

Lt. Chamier of the Ordnance Department, sent us some time ago some clippings of the Cabul Trophy gun at Agra for examination, mentioning that the native belief was that these guns contained considerable proportions of the precious metals. The Sp. gravity was however, found to be only 8.35, that of good gun metal being about 8.40,\* and it was found to be a bad compound of impure (sulphuret of) copper with small proportions of tin, lead, zinc and traces of iron; and certainly containing no trace of gold or silver. As the yellow sulphuret of copper imitates gold in colour, and any white metal might be made to pass for silver, it is probable the native princes and their officers, if they *do* give any gold or silver for the gun, which they might easily be persuaded to do, are thus tricked by the founders. The frauds of goldsmiths and copper founders (*Sonars* and *Khansaries*) are pretty nearly proverbial in India, as witness the well known tale of the goldsmith and the Raja's idol.

Our active contributor Lt. Sherwill, of the Revenue Survey has sent us a highly valuable series of specimens comprising coal from the Rajarrah coal mines in Behar, and the various measures (Strata) which are passed through before it is found; his list is as follows:—

### *Specimens.*

No. 1.—Black stone, found in four separate strata before reaching the 11 feet stratum.

No. 2.—Shale from the 11 feet stratum.

No. 3.—Stone from above or forming the roof of the 11 feet stratum.

No. 4.—Stone found in large masses in the 11 feet stratum.

No. 5.—A piece of coal from the 11 feet stratum covered with pyrites.

No. 6.—A piece of the coal from the 11 feet stratum.

No. 7.—Coarse sandstone, from above the bad coal of an experimental and forsaken pit, this stone is found about 40 feet below the surface of the soil.

No. 8.—Lying under No. 7.

No. 9.—Lying under No. 9.

This pit was forsaken not offering any coal worth quarrying, depth about 75 feet.

Vertical section of the strata in the shafts at Rajharrah Colliery:—

\* The composition of the statue of Louis xv. was copper 82.45, zinc 10.30, tin 4.10, lead 3.15. It sp. grav. 8.482, good cannon metal should contain 90 or 91 of copper, and 9 or 10 per cent. of tin; and as much as 14 per cent. of tin has been used. *Ure's Dictionary.*

						<i>Feet. Inches.</i>	
Loam,	....	....	....	....	....	17	6
White sand stone,	....	....	....	....	....	3	0
Coal, ..	....	....	....	....	....	1	6
Bad coal,	....	....	....	....	....	3	0
Black stone, ....	....	....	....	....	....	3	0
Coal,	....	....	....	....	....	3	0
Black stone, ..	....	....	....	....	....	4	0
Coal, ..	....	....	....	....	....	2	3
Black stone, ..	....	....	....	....	....	2	0
Coal, ..	....	....	....	....	....	1	0
Black stone, ..	....	....	....	....	....	7	0
Coal, ..	....	....	....	....	....	11	0
						58	3 South Pit.

Underneath Black stone or slate,....Unknown depth.

H. S. SHERWILL.

Mr. Martin of Gowhattee, Assam, has again contributed (to our general museum)\* by an assortment of woods from that country 16 in number, completing with the former one of 9 sorts† 24 specimens in all.

No. 254.

*To H. PIDDINGTON, Esq. Curator Museum of Economic Geology.*

SIR,—I have the pleasure to advise you of the despatch to the care of my agents Messrs. T. H. Gardiner, and Co. of sixteen specimens of Assam woods numbered from IX to XIV, a list of which is annexed.

I have the honor to be, Sir,

Gowahattee, 4th Oct. 1844.

Your most obedient servant,

W. N. MARTIN,

*Ex. Off. Lower Assam.*

*List being a continuation of Assam woods,*

IX—Red Pine.	XVII—Bon Som.
X—Bar Parolee.	XVIII—Ahohee Parolee.
XI—Hooroo Kootolah.	XIX—Bur Karooee.
XII—Sisso.	XX—Podocarpus.
XIII—Amaree.	XXI—Coniaree.
XIV—Khootee Kurooe.	XXII—Phool Sapa.
XV—Gondhoree.	XXIII—Hatee Karuhal.
XVI—Kootulnah.	XXIV—Toko Palom.

W. N. MARTIN,

*Ex. Off. Lower Assam.*

\* But as addressed to me I acknowledge it here.

† Proceedings of May, 1844.

From Messrs. Gillanders and Co. I have obtained a cake of artificial fuel, which is the object of a patent at home ; and, as shewing how coal may be œconomised is always a proper addition to our Museum. I do not know the composition of this particular fuel which, however, is probably coal dust and some of the bitumens ; but I may mention that some years ago I ascertained that coal dust mixed in as large a quantity as would hold together with cow dung and a little earth, (the native composition for smearing floors, &c.) forms a capital fuel, where a slow steady fire, as in distilling or sugar drying house work, is required, and I made and burnt several hundred maunds of it. I made a communication to Government (Lord Auckland's) on the subject but never heard any thing in reply.

For all presentations and communications the thanks of the Society were voted.

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